



INTERNATIONAL EVALUATION OF RESEARCH AND DOCTORAL
TRAINING AT THE UNIVERSITY OF HELSINKI 2005–2010

RC-Specific Evaluation of HYRL – Laboratory of Radiochemistry

Seppo Saari & Antti Moilanen (Eds.)



Evaluation Panel: Natural Sciences

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Title: International Evaluation of Research and Doctoral Training at the University of Helsinki 2005–2010 : RC-Specific Evaluation of HYRL – Laboratory of Radiochemistry		Type of publication: Evaluations
Summary: Researcher Community (RC) was a new concept of the participating unit in the evaluation. Participation in the evaluation was voluntary and the RCs had to choose one of the five characteristic categories to participate. Evaluation of the Researcher Community was based on the answers to the evaluation questions. In addition a list of publications and other activities were provided by the TUHAT system. The CWTS/Leiden University conducted analyses for 80 RCs and the Helsinki University Library for 66 RCs. Panellists, 49 and two special experts in five panels evaluated all the evaluation material as a whole and discussed the feedback for RC-specific reports in the panel meetings in Helsinki. The main part of this report is consisted of the feedback which is published as such in the report. Chapters in the report: 1. Background for the evaluation 2. Evaluation feedback for the Researcher Community 3. List of publications 4. List of activities 5. Bibliometric analyses The level of the RCs' success can be concluded from the written feedback together with the numeric evaluation of four evaluation questions and the category fitness. More conclusions of the success can be drawn based on the University-level report.		
RC-specific information:		
Main scientific field of research: Natural Sciences	RC-specific keywords: Radiochemistry Research related to final disposal of spent nuclear fuel Nuclear waste management Radiopharmaceutical chemistry Environmental radioactivity - radioecology	
Participation category: 5. Research of the participating community has a highly significant societal impact		
RC's responsible person: Lehto, Jukka		
Keywords: Research Evaluation, Meta-evaluation, Doctoral Training, Bibliometric Analyses, Researcher Community		

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Foreword

The evaluation of research and doctoral training is being carried out in the years 2010–2012 and will end in 2012. The steering group appointed by the Rector in January 2010 set the conditions for participating in the evaluation and prepared the Terms of Reference to present the evaluation procedure and criteria. The publications and other scientific activities included in the evaluation covered the years 2005–2010.

The participating unit in the evaluation was defined as a Researcher Community (RC). To obtain a critical mass with university-level impact, the number of members was set to range from 20 to 120. The RCs were required to contain researchers in all stages of their research career, from doctoral students to principal investigators (PIs). All in all, 136 Researcher Communities participated in this voluntary evaluation, 5857 persons in total, of whom 1131 were principal investigators. PIs were allowed to participate in two communities in certain cases, and 72 of them used this opportunity and participated in two RCs.

This evaluation enabled researchers to define RCs from the “bottom up” and across disciplines. The aim of the evaluation was not to assess individual performance but a community with shared aims and researcher-training activities. The RCs were able to choose among five different categories that characterised the status and main aims of their research. The steering group considered the process of applying to participate in the evaluation to be important, which led to the establishment of these categories. In addition, providing a service for the RCs to enable them to benchmark their research at the global level was a main goal of the evaluation.

The data for the evaluation consisted of the RCs’ answers to evaluation questions on supplied e-forms and a compilation extracted from the TUHAT – Research Information System (RIS) on 12 April 2011. The compilation covered scientific and other publications as well as certain areas of scientific activities. During the process, the RCs were asked to check the list of publications and other scientific activities and make corrections if needed. These TUHAT compilations are public and available on the evaluation project sites of each RC in the TUHAT-RIS.

In addition to the e-form and TUHAT compilation, University of Leiden (CWTS) carried out bibliometric analyses from the articles included in the Web of Science (WoS). This was done on University and RC levels. In cases where the publication forums of the RC were clearly not represented by the WoS data, the Library of the University of Helsinki conducted a separate analysis of the publications. This was done for 66 RCs representing the humanities and social sciences.

The evaluation office also carried out an enquiry targeted to the supervisors and PhD candidates about the organisation of doctoral studies at the University of Helsinki. This and other documents describing the University and the Finnish higher education system were provided to the panellists.

The panel feedback for each RC is unique and presented as an entity. The first collective evaluation reports available for the whole panel were prepared in July–August 2011. The reports were accessible to all panel members via the electronic evaluation platform in August. Scoring from 1 to 5 was used to complement written feedback in association with evaluation questions 1–4 (scientific focus and quality, doctoral training, societal impact, cooperation) and in addition to the category evaluating the fitness for participation in the evaluation. Panellists used the international level as a point of comparison in the evaluation. Scoring was not expected to go along with a preset deviation.

Each of the draft reports were discussed and dealt with by the panel in meetings in Helsinki (from 11 September to 13 September or from 18 September to 20 September 2011). In these meetings the panels also examined the deviations among the scores and finalised the draft reports together.

The current RC-specific report deals shortly with the background of the evaluation and the terms of participation. The main evaluation feedback is provided in the evaluation report, organised according to the evaluation questions. The original material provided by the RCs for the panellists has been attached to these documents.

On behalf of the evaluation steering group and office, I sincerely wish to thank you warmly for your participation in this evaluation. The effort you made in submitting the data to TUHAT-RIS is gratefully acknowledged by the University. We wish that you find this panel feedback useful in many ways. The bibliometric profiles may open a new view on your publication forums and provide a perspective for discussion on your choice of forums. We especially hope that this evaluation report will help you in setting the future goals of your research.

Johanna Björkroth
Vice-Rector
Chair of the Steering Group of the Evaluation

Steering Group of the evaluation

Steering group, nominated by the Rector of the University, was responsible for the planning of the evaluation and its implementation having altogether 22 meetings between February 2010 and March 2012.

Chair

Vice-Rector, professor **Johanna Björkroth**

Vice-Chair

Professor **Marja Airaksinen**

Chief Information Specialist, Dr **Maria Forsman**

Professor **Arto Mustajoki**

University Lecturer, Dr **Kirsi Pyhälä**

Director of Strategic Planning and Development, Dr **Ossi Tuomi**

Doctoral candidate, MSocSc **Jussi Vauhkonen**

Panel members

CHAIR

Professor Jan-Otto Carlsson

Materials science in chemistry and physics, nanotechnology, inorganic chemistry
Uppsala University, Sweden

VICE-CHAIR

Professor Jan van Leeuwen

Computer science, information technology
University of Utrecht, the Netherlands

Professor Caitlin Buck

Probability and statistics, archeology, palaeoenvironmental science
University of Sheffield, Great Britain

Professor David Colton

Mathematics, inverse problems of acoustic and electromagnetic scattering
University of Delaware, USA

Professor Jean-Pierre Eckmann

Mathematics, dynamical systems, mathematical physics
University of Geneva, Switzerland

Professor Ritske Huismans

Geosciences, geodynamics
University of Bergen, Norway

Professor Jukka Jurvelin

Medical physics and engineering
University of Eastern Finland

Professor Lea Kauppi

Environmental sciences, water research
The Finnish Environment Institute, Finland

Professor Riitta Keiski

Chemical engineering, heterogeneous catalysis, environmental technology, mass and heat transfer processes
University of Oulu, Finland

Professor Mats Larsson

Experimental molecular physics, chemical dynamics, molecular spectroscopy, astrobiology
Stockholm University, Sweden

Professor Holger Stark

Medicinal, organic and pharmaceutical chemistry, pharmacology
Johann Wolfgang Goethe Universität, Germany

The panel, independently, evaluated all the submitted material and was responsible for the feedback of the RC-specific reports. The panel members were asked to confirm whether they had any conflict of interests with the RCs. If this was the case, the panel members disqualified themselves in discussion and report writing.

Added expertise to the evaluation was contributed by the members from the other panels.

Experts from the Other Panels

Professor Barbara Koch, from the Panel of Biological, Agricultural and Veterinary Sciences

Professor Peter York, from the Panel of Medicine, Biomedicine and Health Sciences

EVALUATION OFFICE

Dr Seppo Saari, Doc., Senior Adviser in Evaluation, was responsible for the entire evaluation, its planning and implementation and acted as an Editor-in-chief of the reports.

Dr Eeva Sievi, Doc., Adviser, was responsible for the registration and evaluation material compilations for the panellists. She worked in the evaluation office from August 2010 to July 2011.

MSocSc Paula Ranne, Planning Officer, was responsible for organising the panel meetings and all the other practical issues like agreements and fees and editing a part the RC-specific reports. She worked in the evaluation office from March 2011 to January 2012.

Mr Antti Mollanen, Project Secretary, was responsible for editing the reports. He worked in the evaluation office from January 2012 to April 2012.

TUHAT OFFICE

Provision of the publication and other scientific activity data

Mrs Alja Kaltera, Project Manager of TUHAT-RIS served the project ex officio providing the evaluation project with the updated information from TUHAT-RIS. The TUHAT office assisted in mapping the publications with CWTS/University of Leiden.

MA Liisa Ekebon, Assisting Officer, served in TUHAT-RIS updating the publications for the evaluation. She also assisted the UH/Library analyses.

BA Liisa Jäppinen, Assisting Officer, served in TUHAT-RIS updating the publications for the evaluation.

HELSINKI UNIVERSITY LIBRARY

Provision of the publication analyses

Dr Maria Forsman, Chief Information Specialist in the Helsinki University Library, managed with her 10 colleagues the bibliometric analyses in humanities, social sciences and in other fields of sciences where CWTS analyses were not applicable.

Acronyms and abbreviations applied in the report

External competitive funding

AF – Academy of Finland
TEKES - Finnish Funding Agency for Technology and Innovation
EU - European Union
ERC - European Research Council
International and national foundations
FP7/6 etc. /Framework Programmes/Funding of European Commission

Evaluation marks

Outstanding (5)
Excellent (4)
Very Good (3)
Good (2)
Sufficient (1)

Abbreviations of Bibliometric Indicators

P - Number of publications
TCS – Total number of citations
MCS - Number of citations per publication, excluding self-citations
PNC - Percentage of uncited publications
MNCS - Field-normalized number of citations per publication
MNJS - Field-normalized average journal impact
THCP10 - Field-normalized proportion highly cited publications (top 10%)
INT_COV - Internal coverage, the average amount of references covered by the WoS
WoS – Thomson Reuters Web of Science Databases

Participation category

Category 1. The research of the participating community represents the international cutting edge in its field.
Category 2. The research of the participating community is of high quality, but the community in its present composition has yet to achieve strong international recognition or a clear break-through.
Category 3. The research of the participating community is distinct from mainstream research, and the special features of the research tradition in the field must be considered in the evaluation.
Category 4. The research of the participating community represents an innovative opening.
Category 5. The research of the participating community has a highly significant societal impact.

Research focus areas of the University of Helsinki

Focus area 1: The basic structure, materials and natural resources of the physical world
Focus area 2: The basic structure of life
Focus area 3: The changing environment – clean water
Focus area 4: The thinking and learning human being
Focus area 5: Welfare and safety
Focus area 6: Clinical research
Focus area 7: Precise reasoning
Focus area 8: Language and culture
Focus area 9: Social justice
Focus area 10: Globalisation and social change

1 Introduction to the Evaluation

1.1 RC-specific evaluation reports

The participants in the evaluation of research and doctoral training were Researcher Communities (hereafter referred to as the RC). The RC refers to the group of researchers who registered together in the evaluation of their research and doctoral training. Preconditions in forming RCs were stated in the Guidelines for the Participating Researcher Communities. The RCs defined themselves whether their compositions should be considered well-established or new.

It is essential to emphasise that the evaluation combines both meta-evaluation¹ and traditional research assessment exercise and its focus is both on the research outcomes and procedures associated with research and doctoral training. The approach to the evaluation is enhancement-led where self-evaluation constituted the main information. The answers to the evaluation questions formed together with the information of publications and other scientific activities an entity that was to be reviewed as a whole.

The present evaluation recognizes and justifies the diversity of research practices and publication traditions. Traditional Research Assessment Exercises do not necessarily value high quality research with low volumes or research distinct from mainstream research. It is challenging to expose the diversity of research to fair comparison. To understand the essence of different research practices and to do justice to their diversity was one of the main challenges of the present evaluation method. Understanding the divergent starting points of the RCs demanded sensitivity from the evaluators.

1.2 Aims and objectives in the evaluation

The aims of the evaluation are as follows:

- to improve the level of research and doctoral training at the University of Helsinki and to raise their international profile in accordance with the University's strategic policies. The improvement of doctoral training should be compared to the University's policy.²
- to enhance the research conducted at the University by taking into account the diversity, originality, multidisciplinary nature, success and field-specificity,
- to recognize the conditions and prerequisites under which excellent, original and high-impact research is carried out,
- to offer the academic community the opportunity to receive topical and versatile international peer feedback,
- to better recognize the University's research potential.
- to exploit the University's TUHAT research information system to enable transparency of publishing activities and in the production of reliable, comparable data.

1.3 Evaluation method

The evaluation can be considered as an enhancement-led evaluation. Instead of ranking, the main aim is to provide useful information for the enhancement of research and doctoral training of the participating RCs. The comparison should take into account each field of science and acknowledge their special character.

¹ The panellists did not read research reports or abstracts but instead, they evaluated answers to the evaluation questions, tables and compilations of publications, other scientific activities, bibliometrics or comparable analyses.

² [Policies on doctoral degrees and other postgraduate degrees at the University of Helsinki.](#)

The comparison produced information about the present status and factors that have lead to success. Also challenges in the operations and outcomes were recognized.

The evaluation approach has been designed to recognize better the significance and specific nature of researcher communities and research areas in the multidisciplinary top-level university. Furthermore, one of the aims of the evaluation is to bring to light those evaluation aspects that differ from the prevalent ones. Thus the views of various fields of research can be described and research arising from various starting points understood better. The doctoral training is integrated into the evaluation as a natural component related to research. Operational processes of doctoral training are being examined in the evaluation.

Five stages of the evaluation method were:

1. Registration – Stage 1
2. Self-evaluation – Stage 2
3. TUHAT³ compilations on publications and other scientific activities⁴
4. External evaluation
5. Public reporting

1.4 Implementation of the external evaluation

Five Evaluation Panels

Five evaluation panels consisted of independent, renowned and highly respected experts. The main domains of the panels are:

1. biological, agricultural and veterinary sciences
2. medicine, biomedicine and health sciences
3. natural sciences
4. humanities
5. social sciences

The University invited 10 renowned scientists to act as chairs or vice-chairs of the five panels based on the suggestions of faculties and independent institutes. Besides leading the work of the panel, an additional role of the chairs was to discuss with other panel chairs in order to adopt a broadly similar approach. The panel chairs and vice-chairs had a pre-meeting on 27 May 2011 in Amsterdam.

The panel compositions were nominated by the Rector of the University 27 April 2011. The participating RCs suggested the panel members. The total number of panel members was 50. The reason for a smaller number of panellists as compared to the previous evaluations was the character of the evaluation as a meta-evaluation. The panellists did not read research reports or abstracts but instead, they evaluated answers to the evaluation questions, tables and compilations of publications, other scientific activities, bibliometrics and comparable analyses.

The panel meetings were held in Helsinki:

- On 11–13 September 2011: (1) biological, agricultural and veterinary sciences, (2) medicine, biomedicine and health sciences and (3) natural sciences.
- On 18–20 September 2011: (4) humanities and (5) social sciences.

³ TUHAT (acronym) of Research Information System (RIS) of the University of Helsinki

⁴ Supervision of thesis, prizes and awards, editorial work and peer reviews, participation in committees, boards and networks and public appearances.

1.5 Evaluation material

The main material in the evaluation was the RCs' self-evaluations that were qualitative in character and allowed the RCs to choose what was important to mention or emphasise and what was left unmentioned.

The present evaluation is exceptional at least in the Finnish context because it is based on both the evaluation documentation (self-evaluation questions, publications and other scientific activities) and the bibliometric reports. All documents were delivered to the panellists for examination.

Traditional bibliometrics can be reasonably done mainly in medicine, biosciences and natural sciences when using the Web of Science database, for example. Bibliometrics, provided by CWTS/The Centre for Science and Technology Studies, University of Leiden, cover only the publications that include WoS identification in the TUHAT-RIS.

Traditional bibliometrics are seldom relevant in humanities and social sciences because the international comparable databases do not store every type of high quality research publications, such as books and monographs and scientific journals in other languages than English. The Helsinki University Library has done analysis to the RCs, if their publications were not well represented in the Web of Science databases (RCs should have at least 50 publications and internal coverage of publications more than 40%) – it meant 58 RCs. The bibliometric material for the evaluation panels was available in June 2011. The RC-specific bibliometric reports are attached at the end of each report.

The panels were provided with the evaluation material and all other necessary background information, such as the basic information about the University of Helsinki and the Finnish higher education system.

Evaluation material

1. Registration documents of the RCs for the background information
2. Self evaluation material – answers to the evaluation questions
3. Publications and other scientific activities based on the TUHAT RIS:
 - 3.1. statistics of publications
 - 3.2. list of publications
 - 3.3. statistics of other scientific activities
 - 3.4. list of other scientific activities
4. Bibliometrics and comparable analyses:
 - 4.1. Analyses of publications based on the verification of TUHAT-RIS publications with the Web of Science publications (CWTS/University of Leiden)
 - 4.2. Publication statistics analysed by the Helsinki University Library - mainly for humanities and social sciences
5. University level survey on doctoral training (August 2011)
6. University level analysis on publications 2005–2010 (August 2011) provided by CWTS/University of Leiden

Background material

University of Helsinki

- [Basic information about the University of the Helsinki](#)
- [The structure of doctoral training at the University of Helsinki](#)
- Previous evaluations of research at the University of Helsinki – links to the reports: [1998](#) and [2005](#)

The Finnish Universities/Research Institutes

- [Finnish University system](#)
- [Evaluation of the Finnish National Innovation System](#)
- [The State and Quality of Scientific Research in Finland. Publication of the Academy of Finland 9/09.](#)

The evaluation panels were provided also with other relevant material on request before the meetings in Helsinki.

1.6 Evaluation questions and material

The participating RCs answered the following evaluation questions which are presented according to the evaluation form. In addition, TUHAT RIS was used to provide the **additional material** as explained. For giving the feedback to the RCs, the panellists received the evaluation feedback form constructed in line with the evaluation questions:

1. Focus and quality of the RC's research

- Description of
 - the RC's research focus.
 - the quality of the RC's research (incl. key research questions and results)
 - the scientific significance of the RC's research in the research field(s)
- Identification of the ways to strengthen the focus and improve the quality of the RC's research

The additional material: TUHAT compilation of the RC's publications, analysis of the RC's publications data (provided by University of Leiden and the Helsinki University Library)

A written feedback from the aspects of: scientific quality, scientific significance, societal impact, innovativeness

- Strengths
- Areas of development
- Other remarks
- Recommendations

Numeric evaluation: OUTSTANDING (5), EXCELLENT (4), VERY GOOD (3), GOOD (2), SUFFICIENT (1)

2. Practises and quality of doctoral training

- Organising of the doctoral training in the RC. Description of the RC's principles for:
 - recruitment and selection of doctoral candidates
 - supervision of doctoral candidates
 - collaboration with faculties, departments/institutes, and potential graduate schools/doctoral programmes
 - good practises and quality assurance in doctoral training
 - assuring of good career perspectives for the doctoral candidates/fresh doctorates
- Identification of the RC's strengths and challenges related to the practises and quality of doctoral training, and the actions planned for their development.

The additional material: TUHAT compilation of the RC's other scientific activities/supervision of doctoral dissertations

A written feedback from the aspects of: processes and good practices related to leadership and management

- Strengths
- Areas of development
- Other remarks
- Recommendations

Numeric evaluation: OUTSTANDING (5), EXCELLENT (4), VERY GOOD (3), GOOD (2), SUFFICIENT (1)

3. The societal impact of research and doctoral training

- Description on how the RC interacts with and contributes to the society (collaboration with public, private and/or 3rd sector).
- Identification of the ways to strengthen the societal impact of the RC's research and doctoral training.

The additional material: TUHAT compilation of the RC's other scientific activities.

A written feedback from the aspects of: societal impact, national and international collaboration, innovativeness

- Strengths
- Areas of development
- Other remarks
- Recommendations

Numeric evaluation: OUTSTANDING (5), EXCELLENT (4), VERY GOOD (3), GOOD (2), SUFFICIENT (1)

4. International and national (incl. intersectoral) research collaboration and researcher mobility

- Description of
 - the RC's research collaborations and joint doctoral training activities
 - how the RC has promoted researcher mobility
- Identification of the RC's strengths and challenges related to research collaboration and researcher mobility, and the actions planned for their development.

A written feedback from the aspects of: scientific quality, national and international collaboration

- Strengths
- Areas of development
- Other remarks
- Recommendations

Numeric evaluation: OUTSTANDING (5), EXCELLENT (4), VERY GOOD (3), GOOD (2), SUFFICIENT (1)

5. Operational conditions

- Description of the operational conditions in the RC's research environment (e.g. research infrastructure, balance between research and teaching duties).
- Identification of the RC's strengths and challenges related to operational conditions, and the actions planned for their development.

A written feedback from the aspects of: processes and good practices related to leadership and management

- Strengths
- Areas of development
- Other remarks
- Recommendations

6. Leadership and management in the researcher community

- Description of
 - the execution and processes of leadership in the RC
 - how the management-related responsibilities and roles are distributed in the RC
 - how the leadership- and management-related processes support
 - high quality research
 - collaboration between principal investigators and other researchers in the RC
 - the RC's research focus
 - strengthening of the RC's know-how
- Identification of the RC's strengths and challenges related to leadership and management, and the actions planned for developing the processes

7. External competitive funding of the RC

- The RCs were asked to provide information of such external competitive funding, where:
 - the funding decisions have been made during 1.1.2005-31.12.2010, and
 - the administrator of the funding is/has been the University of Helsinki
- On the e-form the RCs were asked to provide:
 - 1) The relevant funding source(s) from a given list (Academy of Finland/Research Council, TEKES/The Finnish Funding Agency for Technology and Innovation, EU, ERC, foundations, other national funding organisations, other international funding organisations), and
 - 2) The total sum of funding which the organisation in question had decided to allocate to the RCs members during 1.1.2005-31.12.2010.

Competitive funding reported in the text is also to be considered when evaluating this point.

A written feedback from the aspects of: scientific quality, scientific significance, societal impact, innovativeness, future significance

- Strengths
- Areas of development
- Other remarks
- Recommendations

8. The RC's strategic action plan for 2011-2013

- RC's description of their future perspectives in relation to research and doctoral training.

A written feedback from the aspects of: scientific quality, scientific significance, societal impact, processes and good practices related to leadership and management, national and international collaboration, innovativeness, future significance

- Strengths
- Areas of development

- Other remarks
- Recommendations

9. Evaluation of the category of the RC in the context of entity of the evaluation material (1-8)

The RC's fitness to the chosen participation category

A written feedback evaluating the RC's fitness to the chosen participation category

- Strengths
- Areas of development
- Other remarks
- Recommendations

Numeric evaluation: OUTSTANDING (5), EXCELLENT (4), VERY GOOD (3), GOOD (2), SUFFICIENT (1)

10. Short description of how the RC members contributed the compilation of the stage 2 material

Comments on the compilation of evaluation material

11. How the UH's focus areas are presented in the RC's research?

Comments if applicable

12. RC-specific main recommendations based on the previous questions 1-11

13. RC-specific conclusions

1.7 Evaluation criteria

The panellists were expected to give evaluative and analytical feedback to each evaluation question according to their aspects in order to describe and justify the quality of the submitted material. In addition, the evaluation feedback was asked to be pointed out the level of the performance according to the following classifications:

- outstanding (5)
- excellent (4)
- very good (3)
- good (2)
- sufficient (1)

Evaluation according to the criteria was to be made with thorough consideration of the entire evaluation material of the RC in question. Finally, in questions 1-4 and 9, the panellists were expected to classify their written feedback into one of the provided levels (the levels included respective descriptions, 'criteria'). Some panels used decimals in marks. The descriptive level was interpreted according to the integers and not rounding up the decimals by the editors.

Description of criteria levels

Question 1 – FOCUS AND QUALITY OF THE RC'S RESEARCH

Classification: Criteria (level of procedures and results)

Outstanding quality of procedures and results (5)

Outstandingly strong research, also from international perspective. Attracts great international interest with a wide impact, including publications in leading journals and/or monographs published by leading international publishing houses. The research has world leading qualities. The research focus, key research questions scientific significance, societal impact and innovativeness are of outstanding quality.

In cases where the research is of a national character and, in the judgement of the evaluators, should remain so, the concepts of "international attention" or "international impact" etc. in the grading criteria above may be replaced by "international comparability".

Operations and procedures are of outstanding quality, transparent and shared in the community. The improvement of research and other efforts are documented and operations and practices are in alignment with the documentation. The ambition to develop the community together is of outstanding quality.

Excellent quality of procedures and results (4)

Research of excellent quality. Typically published with great impact, also internationally. Without doubt, the research has a leading position in its field in Finland.

Operations and procedures are of excellent quality, transparent and shared in the community. The improvement of research and other efforts are documented and operations and practices are to large extent in alignment with the documentation. The ambition to develop the community together is of excellent quality.

Very good quality of procedures and results (3)

The research is of such very good quality that it attracts wide national and international attention.

Operations and procedures are of very good quality, transparent and shared in the community. The improvement of research and other efforts are documented and operations and practices are to large extent in alignment with the documentation. The ambition to develop the community together is of very good quality.

Good quality of procedures and results (2)

Good research attracting mainly national attention but possessing international potential, extraordinarily high relevance may motivate good research.

Operations and procedures are of good quality, shared occasionally in the community. The improvement of research and other efforts are occasionally documented and operations and practices are to large extent in alignment with the documentation. The ambition to develop the community together is of good quality.

Sufficient quality of procedures and results (1)

In some cases the research is insufficient and reports do not gain wide circulation or do not have national or international attention. Research activities should be revised.

Operations and procedures are of sufficient quality, shared occasionally in the community. The improvement of research and other efforts are occasionally documented and operations and practices are to some extent in alignment with the documentation. The ambition to develop the community together is of sufficient quality.

Question 2 – DOCTORAL TRAINING

Question 3 – SOCIETAL IMPACT

Question 4 – COLLABORATION

Classification: Criteria (level of procedures and results)

Outstanding quality of procedures and results (5)

Procedures are of outstanding quality, transparent and shared in the community. The practices and quality of doctoral training/societal impact/international and national collaboration/leadership and management are documented and operations and practices are in alignment with the documentation. The ambition to develop the community together is of outstanding quality. The procedures and results are regularly evaluated and the feedback has an effect on the planning.

Excellent quality of procedures and results (4)

Procedures are of excellent quality, transparent and shared in the community. The practices and quality of doctoral training/societal impact/international and national collaboration/leadership and management are documented and operations and practices are to large extent in alignment with the documentation. The ambition to develop the community together is of excellent quality. The procedures and outcomes are evaluated and the feedback has an effect on the planning.

Very good quality of procedures and results (3)

Procedures are of very good quality, transparent and shared in the community. The practices and quality of doctoral training/societal impact/international and national collaboration/leadership and

management are documented and operations and practices are to large extent in alignment with the documentation. The ambition to develop the community together is of very good quality.

Good quality of procedures and results (2)

Procedures are of good quality, shared occasionally in the community. The practices and quality of doctoral training/societal impact/international and national collaboration/leadership and management are documented and operations and practices are to large extent in alignment with the documentation. The ambition to develop the community together is of good quality.

Sufficient quality of procedures and results (1)

Procedures are of sufficient quality, transparent and shared in the community. The practices and quality of doctoral training/societal impact/international and national collaboration/leadership and management are occasionally documented and operations and practices are to some extent in alignment with the documentation. The ambition to develop the community together is of sufficient quality.

Question 9 – CATEGORY

Participation category – fitness for the category chosen

The choice and justification for the chosen category below should be reflected in the RC's responses to the evaluation questions 1–8.

1. *The research of the participating community represents the international cutting edge in its field.*
2. *The research of the participating community is of high quality, but the community in its present composition has yet to achieve strong international recognition or a clear break-through.*
3. *The research of the participating community is distinct from mainstream research, and the special features of the research tradition in the field must be considered in the evaluation.* The research is of high quality and has great significance and impact in its field. However, the generally used research evaluation methods do not necessarily shed sufficient light on the merits of the research.
4. *The research of the participating community represents an innovative opening.* A new opening can be an innovative combination of research fields, or it can be proven to have a special social, national or international demand or other significance. Even if the researcher community in its present composition has yet to obtain proof of international success, its members can produce convincing evidence of the high level of their previous research.
5. *The research of the participating community has a highly significant societal impact.* The participating researcher community is able to justify the high social significance of its research. The research may relate to national legislation, media visibility or participation in social debate, or other activities promoting social development and human welfare. In addition to having societal impact, the research must be of a high standard.

An example of outstanding fitness for category choice (5) ⁵

The RC's representation and argumentation for the chosen category were convincing. The RC recognized its real capacity and apparent outcomes in a wider context to the research communities. The specific character of the RC was well-recognized and well stated in the responses. The RC fitted optimally for the category.

- Outstanding (5)
- Excellent (4)
- Very good (3)
- Good (2)
- Sufficient (1)

The above-mentioned definition of outstanding was only an example in order to assist the panellists in the positioning of the classification. There was no exact definition for the category fitness.

⁵ The panels discussed the category fitness and made the final conclusions of the interpretation of it.

1.8 Timetable of the evaluation

The main timetable of the evaluation:

- | | |
|--|-----------------------|
| 1. Registration | November 2010 |
| 2. Submission of self-evaluation materials | January–February 2011 |
| 3. External peer review | May–September 2011 |
| 4. Published reports | March–April 2012 |
| - University level public report | |
| - RC specific reports | |

The entire evaluation was implemented during the university's strategy period 2010–2012. The preliminary results were available for the planning of the following strategy period in late autumn 2011. The evaluation reports will be published in March/April 2012. More detailed time schedule is published in the University report.

1.9 Evaluation feedback – consensus of the entire panel

The panellists evaluated all the RC-specific material before the meetings in Helsinki and mailed the draft reports to the evaluation office. The latest interim versions were on-line available to all the panellists on the Wiki-sites. In September 2011, in Helsinki the panels discussed the material, revised the first draft reports and decided the final numeric evaluation. After the meetings in Helsinki, the panels continued working and finalised the reports before the end of November 2011. The final RC-specific reports are the consensus of the entire panel.

The evaluation reports were written by the panels independently. During the editing process, the evaluation office requested some clarifications from the panels when necessary. The tone and style in the reports were not harmonized in the editing process. All the reports follow the original texts written by the panels as far as it was possible.

The original evaluation material of the RCs, provided for the panellists is attached at the end of the report. It is essential to notice that the exported lists of publications and other scientific activities depend how the data was stored in the TUHAT-RIS by the RCs.

2 Evaluation feedback

2.1 Focus and quality of the RC's research

- *Description of*
 - *the RC's research focus*
 - *the quality of the RC's research (incl. key research questions and results)*
 - *the scientific significance of the RC's research in the research field(s)*
- *Identification of the ways to strengthen the focus and improve the quality of the RC's research*

ASPECTS: Scientific quality, scientific significance, societal impact, innovativeness

The RC is performing research in environmental radioactivity, radionuclides in biosphere, nuclear waste, radiopharmaceutical chemistry, and radiation chemistry. This covers a very broad sector in radiochemistry with numerous successful projects, but it is difficult to see a clear focus in research. In each of these heterogeneous fields some work has been performed, mostly be support from external grants.

Good results have been obtained with some removal of radioactive waste as well as some ion exchangers. The commercialization of these approaches show the impact of such research. The number and the quality of the papers are increasing, especially within the last two years.

The institute is the best in Finland, but it is the only one. In comparison to other European labs the situation concerning publication status and funding is with some exceptions comparable.

The research topics should be condensed to at least three, better two topics which will then be fulfilled with the whole staff to be better visible within the international scientific community. This may help with the development of future vision on the long-term for the RC.

An independent junior group from outside of Finland with support from the head may be established on a related topic to bring fresh impetus into the institute.

Numeric evaluation: 3 (Very good)

2.2 Practises and quality of doctoral training

- *Organising of the doctoral training in the RC. Description of the RC's principles for:*
 - *recruitment and selection of doctoral candidates*
 - *supervision of doctoral candidates*
 - *collaboration with faculties, departments/institutes, and potential graduate schools/doctoral programmes*
 - *good practises and quality assurance in doctoral training*
 - *assuring of good career perspectives for the doctoral candidates/fresh doctorates*
- *Identification of the RC's strengths and challenges related to the practises and quality of doctoral training, and the actions planned for their development.*
- *Additional material: TUHAT compilation of the RC's other scientific activities/supervision of doctoral dissertations*

ASPECTS: Processes and good practices related to leadership and management

An application on a national doctoral program on Nuclear Technology and Radiochemistry seems to be pending. The PHD students are selected and trained without any organized program or any additional specific teaching. The number of positions for people in radiochemistry is rather limited world-wide. Therefore the positions cannot increased dramatically especially for a relative small country like Finland with small radionuclide production. The size of PhD students must be adopted to the need of the nation with some "overproduction" for careers outside of Scandinavia.

The short-term project make it difficult to plan on a longer scale and to introduce well worked-out and radiochemistry specific PhD programs.

There are some international postgraduate diploma / teaching courses in which the institute may contribute or participate.

Numeric evaluation: 3 (Very good)

2.3 The societal impact of research and doctoral training

- *Description on how the RC interacts with and contributes to the society (collaboration with public, private and/or 3rd sector).*
- *Identification of the ways to strengthen the societal impact of the RC's research and doctoral training.*
- *Additional material: TUHAT compilation of the RC's other scientific activities.*

ASPECTS: Societal impact, national and international collaboration, innovativeness

The field of radiochemistry has high social impact if it can be seen with the Fukushima disaster, the Chernobyl accident or the implication of 18F PET and SPECT studies for diagnostics. Although nuclear waste is a clear topic of the RC the connection of help for social tasks from the institute in a general way can be seen in the focused scientific community only.

The SPECT and PET studies have been established and show a number of promising publications in regular journals on radiochemistry/radiopharmacy.

Dr. O. Heinonen, mentioned as example for public encouragement as former IAEA director, has not been found as RC member.

As mentioned in the report PET /SPECT radionuclide production has been established many years ago and now taken over by regular industrial production. Although novel equipment has been introduced the high impact with new diagnostics or accelerated clinical studies with great interests in the general community or especially with pharmaceutical industry have not been established so far.

Here the impact of the RC can be enhanced by greater visibility in the non-scientific community by public lectures etc. with broad topics.

One suggestion to enhance the acceptance and the visibility of the HU may be a "Night of Science" or an "Open Day" where each group shows some topics of general interest. To my experience this attracts young pupils as well as settled people and gives enormous social impact.

Numeric evaluation: 3 (Very good)

2.4 International and national (incl. intersectoral) research collaboration and researcher mobility

- *Description of*
 - *the RC's research collaborations and joint doctoral training activities*
 - *how the RC has promoted researcher mobility*
- *Identification of the RC's strengths and challenges related to research collaboration and researcher mobility, and the actions planned for their development.*

ASPECTS: Scientific quality, national and international collaboration

Numerous exchange programs are performed with other European countries. Even international supervision has been put into PHD education. With the limited possibilities for scientific exchange within the national radiochemistry community the exchange with European and non-European countries is essential for the quality of research and for the reputation. Although the RC has already reached a good level in the exchange status and the process of internationalization further strength should be put on additional increase.

Numeric evaluation: 4 (Excellent)

2.5 Operational conditions

- *Description of the operational conditions in the RC's research environment (e.g. research infrastructure, balance between research and teaching duties).*
- *Identification of the RC's strengths and challenges related to operational conditions, and the actions planned for their development.*

ASPECTS: Processes and good practices related to leadership and management

The RC has good working conditions with a well-equipped infrastructure. Maintenance of state-of-the-art instrumentation has strategically to be planned on the longer timescale.

2.6 Leadership and management in the researcher community

- *Description of*
 - *the execution and processes of leadership in the RC*
 - *how the management-related responsibilities and roles are distributed in the RC*
 - *how the leadership- and management-related processes support*
 - *high quality research*
 - *collaboration between principal investigators and other researchers in the RC*
 - *the RC's research focus*
 - *strengthening of the RC's know-how*
- *Identification of the RC's strengths and challenges related to leadership and management, and the actions planned for developing the processes*

ASPECTS: Processes and good practices related to leadership and management

The RC has shown good to very good leadership within the national scientific community. The visibility for the international community is good and in wide range within different networks, but can and should be increased.

2.7 External competitive funding of the RC

- *The RCs were asked to provide information of such external competitive funding, where:*
 - *the funding decisions have been made during 1.1.2005–31.12.2010, and*
 - *the administrator of the funding is/has been the University of Helsinki*
- *On the e-form the RCs were asked to provide:*
 - 1) *The relevant funding source(s) from a given list (Academy of Finland/Research Council, TEKES/The Finnish Funding Agency for Technology and Innovation, EU, ERC, foundations, other national funding organisations, other international funding organizations), and*
 - 2) *The total sum of funding which the organisation in question had decided to allocate to the RCs members during 1.1.2005–31.12.2010.*

Competitive funding reported in the text is also to be considered when evaluating this point.

ASPECTS: Scientific quality, scientific significance, societal impact, innovativeness and future significance

The national and international funding is at an excellent level and with a broad conception for such a small RC.

2.8 The RC's strategic action plan for 2011–2013

• *RC's description of their future perspectives in relation to research and doctoral training.*

ASPECTS: Scientific quality, scientific significance, societal impact, processes and good practices related to leadership and management, national and international collaboration, innovativeness, future significance

The strategic plan shows a continuation of the actually already performed studies. On the one hand this seems reasonable, but a focus on a smaller number of different project with good overlap to other RC at UH may increase the excellence on a longer time scale.

2.9 Evaluation of the category of the RC in the context of entity of the evaluation material (1-8)

The RC's fitness to the chosen participation category.

Category 5. The research of the participating community has a highly significant societal impact.

The RC is the national leading and only academic research team on that topic. It has achieved good internationalization and output in form of paper and patents. The innovative character could still be improved but it is always difficult to have long-term projects and future visions if the financing of personal on project bound and mostly short-termed. The permanent staff may be divided into basic research and applied research which may allow the focus on a small number of main topics.

The category 4 would be more appropriate.

Numeric evaluation: 4 (Excellent)

2.10 Short description of how the RC members contributed the compilation of the stage 2 material

The material has been contributed by all PI of the RC with open discussion in a constructive way.

2.11 How the UH's focus areas are presented in the RC's research

Focus area 5: Welfare and safety

Good presentation in the different fields of life sciences, ecologic and environmental topics.

2.12 RC-specific main recommendations

A clear advantage with a focus on two or three main research topics can be seen. Additional co-operations with industry and STUK may further increase the success in science.

Since this is a highly specific RC with a small scientific community in a small country the national as well as international networking is essential to go to break.

2.13 RC-specific conclusions

The role for leadership should be focused on a small number of main topics with a larger international network. The international exchange of scientists should be supported.

2.14 Preliminary findings in the Panel-specific feedback

The RC is performing research in environmental radioactivity, radionuclides in biosphere, nuclear waste, radiopharmaceutical chemistry, and radiation chemistry at a very good international and national level.

With the novel application for a doctoral education program the RC is in an excellent was for a further improved education.

The research topics have extremely high societal impact (as seen with the Fukushima disaster).

The excellent funding situation represents the high activity of this RC and the need for research in this topic.

The general role as the national leading RC in this field could be strengthened by the focus on a restricted number of main topics.

The international exchange should be encouraged to increase the EU network and the visibility.

2.15 Preliminary findings in the University-level evaluation

The research on radiochemistry may be one important area in the future for fuel, environment and life science.

The broad topics are covered by the RC in multiple ways, with a recommendation for sharpening the expertises on smaller number of topics.

The excellent funding situation is combined with excellent network at the PI level. The scientist exchange could be enlarged with further EU networking.

The small scientific community allows only very rarely the publication of high input papers (with high IF). Therefore the number and the quality of output papers and patents is very good to excellent.

3 Appendices

- A. Original evaluation material
 - a. Registration material – Stage 1
 - b. Answers to evaluation questions – Stage 2
 - c. List of publications
 - d. List of other scientific activities
- B. Bibliometric analyses
 - a. Analysis provided by CWTS/University of Leiden
 - b. Analysis provided by Helsinki University Library (66 RCs)



International evaluation of research and doctoral training
at the University of Helsinki 2005-2010

RC-SPECIFIC MATERIAL FOR THE PEER REVIEW

NAME OF THE RESEARCHER COMMUNITY:

Laboratory of Radiochemistry (HYRL)

LEADER OF THE RESEARCHER COMMUNITY:

Professor Jukka Lehto, Laboratory of Radiochemistry, Department of Chemistry, Faculty of Science

RC-SPECIFIC MATERIAL FOR THE PEER REVIEW:

- Material submitted by the RC at stages 1 and 2 of the evaluation
 - STAGE 1 material: RC's registration form (incl. list of RC participants in an excel table)
 - STAGE 2 material: RC's answers to evaluation questions
- TUHAT compilations of the RC members' publications 1.1.2005-31.12.2010
- TUHAT compilations of the RC members' other scientific activities 1.1.2005-31.12.2010
- Web of Science(WoS)-based bibliometrics of the RC's publications data 1.1.2005-31.12.2010 (analysis carried out by CWTS, Leiden University)

NB! Since Web of Science(WoS)-based bibliometrics does not provide representative results for most RCs representing humanities, social sciences and computer sciences, the publications of these RCs will be analyzed by the UH Library (results available by the end of June, 2011)



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RC-SPECIFIC STAGE 1 MATERIAL (registration form)

1 RESPONSIBLE PERSON

Name: Lehto, Jukka

E-mail:

Phone: +358919140151

Affiliation: professor, head of the Laboratory of Radiochemistry

Street address: A.I.Virtasen aukio 1

2 DESCRIPTION OF THE PARTICIPATING RESEARCHER COMMUNITY (RC)

Name of the participating RC (max. 30 characters): Laboratory of Radiochemistry, Department of Chemistry

Acronym for the participating RC (max. 10 characters): HYRL

Description of the operational basis in 2005-2010 (eg. research collaboration, joint doctoral training activities) on which the RC was formed (MAX. 2200 characters with spaces): The Laboratory of Radiochemistry (HYRL) is one of the nine units at the Department of Chemistry. It is the only general radiochemistry unit within Finnish universities and the only unit granting MSc and PhD of radiochemistry degrees in Finland. With the thirty employees it is among the largest academic radiochemistry institutes internationally. In addition to thirteen doctoral students, HYRL has four principal investigators, eight senior and other researchers and four adjunct professors (docents) having thus good human resources for successful research and doctoral training. The total budget of HYRL is approximately 2 million euros of which only less than one fourth comes from the university. All research and doctoral training is carried by external funding coming from the Academy of Finland, TEKES, EU, industry, Ministry of Employment and Economy etc. Though the diversity of research fields (see below) HYRL is a uniform research institute and all research and doctoral training is coordinated and managed systematically.

3 SCIENTIFIC FIELDS OF THE RC

Main scientific field of the RC's research: natural sciences

RC's scientific subfield 1: Chemistry, Multidisciplinary

RC's scientific subfield 2: Nuclear Science and Technology

RC's scientific subfield 3: Chemistry, Medicinal

RC's scientific subfield 4: Environmental Sciences

Other, if not in the list:

4 RC'S PARTICIPATION CATEGORY

Participation category: 5. Research of the participating community has a highly significant societal impact



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Justification for the selected participation category (MAX. 2200 characters with spaces): The education and research of HYRL have considerable impact on the Finnish society. It is the only academic unit educating radiochemistry MSc's and PhD's to fulfil the expert needs of research community, authorities and industry in Finland. In international organisations, there has also been a demand for Finnish radiochemists as national representatives or experts, e.g. Dr. Olli Heinonen acted several years as the general deputy director of the IAEA. The research of HYRL has been mostly application-oriented aiming to serve the needs of the Finnish society. In the 1960s and 1970s when radioactive fallout from the atmospheric nuclear was a great national concern, HYRL then led by Prof. J.K. Miettinen (now one of twelve Finnish academicians), established radioecological research in Finland and radiological consequences of the fall-out were extensively surveyed. Since the 1980s the main research field of HYRL has been related to nuclear waste management and disposal in which HYRL plays a central national role with studies on migration of radionuclides in geosphere and biosphere. These have aided the industry and authorities to evaluate the safety of the final disposal of spent nuclear fuel from Finnish nuclear power plants, with initial legislation and plans to commission the final repository for spent nuclear fuel in 2020, first among the nuclear generating countries. Very fruitful cooperation with the Finnish industry has led also to two commercial applications. First, several inorganic ion exchangers developed by HYRL and commercialised by Fortum Ltd. are utilised in nuclear waste effluent treatment in Finland and in other countries. Further development is underway with Loviisa NPP for new liquid waste treatment systems. The other achievement was the start of production of ¹⁸F-labelled FDG radiopharmaceutical for Finnish hospitals ten years ago. Now a Finnish company MAP Medical has taken over production of ¹⁸F-labelled FDG for clinical applications and HYRL is now, in cooperation with several academic partners, focusing on preclinical development of new radiopharmaceuticals for diagnostics and drug development.

5 DESCRIPTION OF THE RC'S RESEARCH AND DOCTORAL TRAINING

Public description of the RC's research and doctoral training (MAX. 2200 characters with spaces): Research of the Laboratory of Radiochemistry covers the most important areas of radiochemistry and has five major fields. The largest research is carried out in migration and retention of radionuclides in geosphere and biosphere related to the final disposal of spent nuclear fuel from the Finnish nuclear power plant. There are eight students carrying out their doctoral thesis research in sorption of long-lived waste radionuclides by minerals, diffusion of radionuclides in fractured bedrock and characterization of rock porosities. Another research field related to nuclear waste is the development of inorganic sorbents for the purification of nuclear waste effluent where currently one student is carrying out doctoral thesis work. Third field is radiopharmaceutical chemistry, where the major research topics are development of new radiotracers for following nanoparticle mediated drug delivery with non-invasive nuclear imaging modalities; positron emission tomography (PET) and single photon emission computed tomography (SPECT) and new radiopharmaceuticals for brain imaging. Three doctoral students are doing research within these topics. The fourth field is environmental radioactivity studies where one doctoral student is studying immobilization of radionuclides from mining mill tailings. In addition to radionuclides, also heavy metals in the environment have been rather extensively studied. The fifth field is radiation chemistry where one doctoral student is developing track etch membranes. The number of doctoral degrees and in the evaluation period from 2005 to 2010 has been four. The number of doctoral students at the moment is higher than ever, altogether thirteen, and the expected annual number of doctoral degrees in the coming



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RC-SPECIFIC STAGE 1 MATERIAL (registration form)

five to six years will be two to three. The doctoral students are supervised by senior scientists in the laboratory and in addition to them there are four foreign professors acting as supervisors.

Significance of the RC's research and doctoral training for the University of Helsinki (MAX. 2200 characters with spaces): As the only general radiochemistry unit within Finnish universities HYRL has a special importance for the University of Helsinki since it educates radiochemistry masters and doctors for the whole country and also for the international forum. Due to its unique multidisciplinary research it also serves the university in profilation to strong research areas. HYRL is not only a research and education unit but also a respected expert institution representing the whole area of radiochemistry in the Finnish society and thus serves the University in promoting its third principal mission, societal impact. This was clearly recognised in 2005 by the international research evaluation group who stated on the HYRL's research and education profile "This is an excellent example of the work of the department having significant benefits to society and many of the scientist trained in this Laboratory have been appointed to positions in radiochemistry in Finland and in other countries".

Keywords: Radiochemistry

Research related to final disposal of spent nuclear fuel

Nuclear waste management

Radiopharmaceutical chemistry

Environmental radioactivity - radioecology

6 QUALITY OF RC'S RESEARCH AND DOCTORAL TRAINING

Justified estimate of the quality of the RC's research and doctoral training at national and international level during 2005-2010 (MAX. 2200 characters with spaces): At the Department of Chemistry, a leading chemistry institution in Finland, HYRLs share of scientific publications and doctoral degrees have been approximately at the same level as the HYRLs shares of the funding and the personnel at the department are. Since HYRL is the only general radiochemistry unit within Finnish universities, no direct comparison can be done to similar institutions. However, there are some institutes doing partly similar research and HYRL is closely collaborating with them. Without a doubt the radionuclide migration and retention studies in geosphere at HYRL are nationally at the top and on an internationally good level. Unique development of inorganic ion exchangers done at HYRL does certainly not find any serious competitor even internationally. During the evaluation period major strategic effort has been focused on creating infrastructure, considering both human and material resources, to the radiopharmaceutical research. Therefore, the results of this research area can be seen only at the three last years of the evaluation period and it is expected that this area will have a major scientific input of the laboratory in the coming years. At present, the research in this area, though still in its initial phase, is at a very good international level. The resources of the radioecological research at HYRL have been rather limited but nevertheless the outcome of this area to the total research of the laboratory has been much more than the funding to this area would suggest. In general, the quality of research at HYRL has increased due to the introduction of new, most advanced analytical methods in research. Since the laboratory does not have most analytical equipment itself, this has been accomplished by wide-scale collaboration with other institutes, especially in Germany and France.



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RC-SPECIFIC STAGE 1 MATERIAL (registration form)

One important indication of the quality of PhD education is that all persons that have obtained a PhD's at HYRL have been employed with no delay in good positions in Finland and abroad.

Comments on how the RC's scientific productivity and doctoral training should be evaluated (MAX. 2200 characters with spaces): The productivity in scientific publications and doctoral degrees during the assessment period has been good: 170 publications in total, including 75 papers in international refereed scientific journals, and 4 doctoral degrees. As the research of HYRL is mostly application-oriented and carried out in close cooperation with industry, publication of results often takes place in national edited series (e.g. Posiva series) rather than in prime refereed journals. Some sensitive material remains unpublished or publication is delayed considerably due to IPR issues. There has been a temporary drop on publications in 2007 and doctoral degrees in the later years of the assessment period. This drop is expected to have been caused by the instability due to the four years' transition period in the permanent replacement of the radiochemistry professorship in 2000-2005. A major problem in the PhD production from 2005 onwards has been the "leak" of doctoral students to jobs in industry before graduation, due to urgent need of industry for radiochemical experts. The publication rate has, however, increased considerably during the last few years and in 2009 the number of refereed scientific journal papers was higher than ever and the number in 2010 will be at the same level. The publication rate and the quality of papers of HYRL are at a good international level. The number of doctoral students has doubled during the assessment period and this will certainly reflect in increasing number of doctoral degrees and scientific publications in the coming years. The results of research have been published in three forms: in refereed scientific journals, in conference proceedings and in edited report series. There are two major points in publishing strategy of the laboratory. First, the number of refereed scientific journal articles should be increased, as indeed has already taken place. In the coming years the goal is to publish 20-25 refereed articles annually. Another goal is to teach the doctoral student scientific article writing in as early stage as possible.

LIST OF RC MEMBERS

NAME OF THE RESEARCHER COMMUNITY:			Laboratory of Radiochemistry, Department of Chemistry, Faculty of Science, University of Helsinki (HYRL)		
RC-LEADER			J. Lehto		
CATEGORY			5		
	Last name	First name	PI-status (TUHAT, 29.11.2010)	Title of research and teaching personnel	Affiliation
1	Airaksinen	Anu	X	Postdoctoral researcher-University researcher (Academy Research Fellow)	HYRL
2	Borai	Emad		Visiting professor (Marie Curie)	HYRL
3	Ervanne	Heini		Researcher	HYRL
4	Hakanen	Martti		Laboratory manager	HYRL
5	Harjula	Risto	X	University lecturer, Docent	HYRL
6	Helariutta	Kerttuli	X	Senior laboratory manager	HYRL
7	Huittinen	Nina		Doctoral candidate	HYRL
8	Hölttä	Pirkko		Senior researcher	HYRL
9	Ikonen	Jussi		Doctoral candidate	HYRL
10	Jernström	Jussi		Doctoral candidate- Postdoctoral researcher	HYRL
11	Jokelainen	Lalli		Doctoral candidate	HYRL
12	Kelokaski	Maarit		Doctoral candidate	HYRL
13	Kelokaski	Pasi		Researcher	HYRL (no more in RC)
14	Koivula	Teija		Doctoral candidate	HYRL
15	Koivula	Risto		Postdoctoral researcher	HYRL
16	Kyllönen	Jarkko		Researcher	HYRL (no more in RC)
17	Lahtinen	Mari		Doctoral candidate	HYRL
18	Lehto	Jukka	X	Professor	HYRL
19	Leskinen	Anumaija		Researcher	HYRL (no more in RC)
20	Lipponen	Tiina		Doctoral candidate	HYRL
21	Lusa	Merja		Doctoral candidate	HYRL
22	Makkonen-Craig	Stewart		Doctoral candidate	HYRL
23	Malinen	Leena		Doctoral candidate	HYRL
24	Myllykylä	Emmi		Doctoral candidate	VTT
25	Nyman	Markus		Senior laboratory manager (subs.)	HYRL
26	Paajanen	Airi		Researcher	HYRL
27	Palosaari-Pehkonen	Miia		Doctoral candidate	HYRL (no more in RC)
28	Pehrman	Reijo		Researcher	HYRL
29	Penttinen-Togneri	Laura		Doctoral candidate	HYRL (no more in RC)
30	Perhola	Outi		Researcher	HYRL
31	Pinnioja	Sinikka		University lecturer	HYRL (no more in RC)
32	Puukko	Esa		Researcher	HYRL
33	Salminen	Susanna		Doctoral candidate-Postdoctoral researcher	HYRL
34	Sarparanta	Mirkka		Doctoral candidate	HYRL
35	Siitari-Kauppi	Marja	X	Senior researcher-University lecturer	HYRL
36	Suksi	Juhani		Senior researcher, Docent	HYRL
37	Söderlund	Mervi		Doctoral candidate	HYRL
38	Tuovinen	Hanna		Doctoral candidate	HYRL
39	Vaaramaa	Kaisa		Postdoctoral researcher	HYRL (no more in RC)



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RC-SPECIFIC STAGE 2 MATERIAL

BACKGROUND INFORMATION

Name of the RC's responsible person: Lehto, Jukka

E-mail of the RC's responsible person:

Name and acronym of the participating RC: Laboratory of Radiochemistry, Department of Chemistry, University of Helsinki, HYRL

The RC's research represents the following key focus area of UH: 5. Hyvinvointi ja turvallisuus – Welfare and safety

Comments for selecting/not selecting the key focus area: Key focus area 5: Development of new radiopharmaceuticals aims at better health of people, a most important part of their welfare. Research on the migration and retention of radionuclides in bedrock and soil plays a key role in assessing the safety of geological disposal of spent nuclear fuel from Finnish nuclear power reactors. Other key focus areas: 1: The ion exchange team at HYRL has extensive expertise in the R&D of inorganic ion exchange materials for the removal of harmful substances from industrial effluents, including the development of several commercial materials with the Finnish nuclear industry. 3: Contamination of natural waters in lakes and the Baltic Sea by radionuclides and heavy metals has been extensively studied. The quality of water is also a fundamental motivation in developing new ion exchangers and in exploring the behaviour in ground water of radionuclides, originating from nuclear waste. 6: Clinical applications are the long term goal for the new radiopharmaceuticals developed at HYRL.

1 FOCUS AND QUALITY OF RC'S RESEARCH (MAX. 8800 CHARACTERS WITH SPACES)

- **Description of the RC's research focus, the quality of the RC's research (incl. key research questions and results) and the scientific significance of the RC's research for the research field(s).**

The Laboratory of Radiochemistry, established in 1963, is the only general radiochemistry unit within Finnish universities and internationally it is a large academic radiochemical institute. The research strategy of the laboratory has always been more or less application-oriented and the objective of the research programme has been to aid the Finnish society to solve and better understand problems related to behaviour and use of radioactive elements and radiation. To better serve this strategy the laboratory is putting more effort on studying various processes deeper in atomic and molecular scale and to use most modern physicochemical techniques in its research. The main research fields of HYRL are:

Migration and retention of radionuclides in the geosphere. With fifteen researchers and doctoral students HYRL has a major national and also international role in the research on the behaviour of long-lived radionuclides, expected to potentially dissolve from spent nuclear fuel and migrate into the geosphere. The major idea in the research has been to study sorption mechanisms of radionuclides on the mineral surfaces occurring in fractures and their diffusion into the rock matrix. Quite a number of research topics have been covered in this area, including:

- redox behaviour of uranium in bedrock in context of groundwater and oxic glacial meltwater recharge
- sorption mechanisms of trivalent actinides on hydroxyl groups on the surfaces of clay and oxide minerals, studied by laser-induced fluorescence spectroscopy and sorption experiments
- presence of colloids in ground waters and their function in radionuclide transport
- sorption and migration of long-lived anionic radionuclides (Tc, I, Cl, Se, Mo etc.) in bedrock and in soil
- sorption and diffusion of long-lived radionuclides in rocks



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In addition to sorption and migration studies a unique method to characterize the pore space structure of rocks has been developed and used, not only in Finland but in several other countries. This method is based on impregnation of ^{14}C -labelled methyl methacrylate into the pores of geological material, irradiation or heat polymerisation of monomer inside the rock and characterization of the pore structure with autoradiography. In recent years, the research has been directed also to the investigation on the behaviour of radionuclides in the engineered barriers of the nuclear waste repository as well as on the dissolution behaviour of spent fuel.

Development of inorganic ion exchangers for the removal of radionuclides from nuclear waste effluents. Long-term research has been carried to develop new highly selective ion exchange materials for the treatment of radioactive waste liquids. Three of the exchangers are being manufactured at the industrial scale by the Finnish company Fortum and they are now being used in various nuclear sites worldwide, e.g. in Finland, Russia, UK and USA. We continue to develop materials to remove oxoanionic radionuclides and radioactive organic metal complexes from solution. Recent tests have shown very good removal of radioactive Sb-125 (antimonate) from the primary coolant of Loviisa nuclear power plant, Finland. New areas of research include development of novel track-etch membranes and separation of long-lived actinides from spent nuclear fuel for transmutation. In addition, a research project has been just started to develop new effective separation methods for rare earth metals.

Radiopharmaceutical chemistry. Radiopharmaceutical chemistry is the most recent member among the multidisciplinary research topics at HYRL. A medical cyclotron for production of short-lived radioisotopes was installed in 1998. Since then, radiopharmaceutical chemistry has been one of the emerging research topics at the laboratory. Reorganization and modernization of the laboratory's radiopharmaceutical chemistry research, as well as research facilities, was started in 2006 and currently the research group consists of two senior scientists and three PhD-students and it has state-of-the-art research facilities for tracer development for positron emission tomography (PET) and for single photon emission tomography (SPECT). The research of the group is strongly orientated to preclinical development of new tracers. The main interests of the group are design and development of new tracers for brain imaging and for imaging nanoparticle mediated drug delivery process, including the related tracer evaluation in animal models. Within these topics, the group has closely networked with national academic research groups in pharmaceutical sciences and in material science, as well as with international and national research groups in imaging.

Studies on environmental radioactivity – radioecology. Although resources in radioecological studies are small this area has remained an important research area in the laboratory. The main effort in environmental studies has been put on behaviour of transuranium elements (Np, Pu, Am, Cm) and on radioactive cesium, the main artificial contributor to human dose. Their sources in the Finnish environment are the fallouts from the nuclear weapons tests and from the Chernobyl accident. Natural radionuclides, in recent years especially polonium and radiolead, have gained increasing interest in the laboratory's research, and their distribution in forest soil and transfer into berries and mushrooms have been explored. In the early years of the assessment period HYRL also participated in the radiological evaluation of the former nuclear weapons test site at Semipalatinsk in Kazakhstan. The newest research in this area started in 2010 when an Academy of Finland funded project on immobilization of radionuclides and heavy metals from mining mill tailings was started.

The quality of the research at HYRL is nationally at the top level and internationally at a good level. The high quality is ensured by a high number of both senior scientists and doctoral students, good funding situation, good infrastructure and the large number of national and international collaborators. The increasing quality can be first of all seen in the increasing number of research papers during the



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assessment period. While the average annual number of the peer-reviewed journal articles and conference proceedings in the 2005-2007 was 18 it has increased to 28 in 2008-2010. Another most important indication of the increasing quality of the research is the utilization of new advanced research techniques and instruments, such as various spectroscopic methods (LIF, NMR, IR) in studying the sorption mechanisms of radionuclides on mineral surfaces and the modern infrastructure installed during the assessment period for the radiopharmaceutical research (automated synthesis units, facilities for preclinical tracer evaluation etc.).

HYRL's research related to spent nuclear fuel disposal, especially studies on the migration and retention of nuclear waste radionuclides in the geosphere is nationally of high importance and HYRL plays a leading role in this field. Considering the number of researchers and the scientific output HYRL is also among the largest academic units internationally in this area. In the development of inorganic ion exchangers HYRL is a small but very unique unit and practically no serious academic competitors exist. The scientific significance of the radiopharmaceutical research at HYRL has dramatically increased during the assessment period due to reconstruction of the facilities and the group and the scientific output of the research will further increase during the next few years. The radioecology studies are of high national importance and at a g

- **Ways to strengthen the focus and improve the quality of the RC's research.**

The research focus of HYRL is very wide and it is probable that the spectrum will not radically change in the coming five to ten years. Within each research area, however, new topics have been and will be covered at a rather fast rate and therefore the number on research personnel has increased by 25% during the assessment period. The quality of the research has been and will be improved in various ways. First of all the number of peer-reviewed articles in high quality international journals each year will be increased, from nearly twenty today to at least twenty five in the next five years. Another way to improve the quality of the research is to apply most modern analytical techniques and to focus on studies shedding light on phenomena at atomic and molecular scale. The high number of national and international research partners will enable use of various techniques and expertise that are not available at HYRL. A third way to improve quality is to increase international exchange of senior researchers and doctoral students, in both directions.

2 PRACTISES AND QUALITY OF DOCTORAL TRAINING (MAX. 8800 CHARACTERS WITH SPACES)

- How is doctoral training organised in the RC? Description of the RC's principles for recruitment and selection of doctoral candidates, supervision of doctoral candidates, collaboration with faculties, departments/institutes, and potential graduate schools/doctoral programmes, good practises and quality assurance in doctoral training, and assuring good career perspectives for the doctoral candidates/fresh doctorates.

HYRL has presently thirteen doctoral students. There are no doctoral training positions funded by regular University budget and all doctoral students do their work in research projects funded externally (EU, Academy of Finland, TEKES, Public Nuclear Waste Management Program, industrial funding e.g. Posiva). One doctoral student is a member of a national Ministry of Education funded graduate school, Drug Discovery Graduate School (DDGS). Generally, external funding is sought by project leaders who also prepare the research plans. In case additional funding is sought for existing project (e.g. period-funded KYT and TEKES projects), doctoral students may contribute considerably in the preparation of the research plan. When funding for a new project involving doctoral students has been granted, the doctoral position is advertised in cooperation with Personnel Department in various media (HU and other university web pages, national Employment Office web pages, newspapers). Recently, advertisement of a doctoral position yielded in nearly 50 applications from 14 different countries. A



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large fraction on doctoral students has not been selected by open calls due to short-term funding. In these cases the students are first hired for shorter periods and later, if funding appears to stabilise, for longer times.

Applications are first assessed by the group leader. Assessment criteria include success of previous studies, previous scientific merits (e.g. publications), previous experience in laboratory work and subject area of project etc. The 2-3 highest ranking candidates are called for a personal interview to further assess communication and social skills and motivation of the candidate. The assessor makes a recommendation for the best candidate to the head of HYRL who makes a hiring proposal to the director of the Department of Chemistry for final decision of employment. After the candidate has been hired in the project, the research plan is assessed and approved by a departmental board consisting of two professors. After the approval of the research plan, the final decision for doctoral student status is made by the Faculty.

Doctoral students are supervised on a three-level hierarchy. A senior supervisor (professor or senior project leader, typically meeting the student twice a month) is responsible for overall execution of the candidate's research work and study plan. The senior supervisor also oversees the scientific quality of research work and advice on major scientific issues. A junior supervisor (postdoctoral worker, typically meeting the candidate several times a week) oversees the practical working in the laboratory, advising on work procedures and use of equipment. Other postdoctoral students in the research laboratory provide peer assistance on a daily basis on their specialised areas when necessary.

Many doctoral students are also co-supervised by external professors or docents (adjunct professors) from Finnish universities and research institutes, e.g. VTT, GTK, STUK, Arcada Polytechnic, any may use the specialised equipment available in these institutes for part of their work. Typically these are joint research projects of HYRL with other research institutes and universities. Presently there are also four doctoral students that have a professor level co-supervisor from other countries (Sweden, UK, France and Germany).

Many of the doctoral students do part of their research work (typically 6-12 months) using dedicated facilities available in foreign universities and research centres having joint research projects with HYRL. These institutes and universities include Institute of Transuranium Elements (EU JRC Karlsruhe), Karlsruhe Institute of Technology, University of Poitiers, Czech Technical University in Prague, Royal Institute of Technology in Stockholm, and Karolinska Institute in Stockholm. HYRL is also a core partner in an EU project CINCH (Cooperation in Education of Nuclear Chemistry), developing nuclear and radiochemistry education and training in Europe. This project provides new challenges for HYRL in its doctoral training.

Doctoral students publish their research results in international peer-reviewed scientific journals. Typically, the PhD thesis consists of 4-5 such articles and a summary report thereof. The peer review process is the primary tool for the assessment of scientific quality of HYRL's doctoral training. Another indication for the quality is that all PhD graduates from HYRL have found employment, often in good positions in Finnish companies, research organisations and regulating bodies, but also in enterprises and organisations abroad. This has been achieved by active research cooperation with these employing bodies and no other action has been necessary to employ the graduated PhDs. During the assessment period the number of doctoral degrees has been lower than in the previous six year period. This is expected to have been caused by a very long transition period in replacement of the radiochemistry professorship in the first half of the decade. In the coming years the annual number of doctoral degrees will increase to approximately two.



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- RC's strengths and challenges related to the practises and quality of doctoral training, and the actions planned for their development.

While there is plentiful cooperation on project level, the lack of long term national coordination and funding has been a serious problem in the doctoral training of radiochemists at HYRL and in Finland. Short-term research projects have often been unable to provide a secure path for the doctoral students to complete their degree and this has resulted in a serious leak of doctoral students to jobs in industry and elsewhere before they complete their degree. To address this problem HYRL, Aalto Yliopisto and Lappeenranta University have applied funding for a national doctoral programme on Nuclear Technology and Radiochemistry. The application is supported by all national industrial, regulatory and research actors of the field in Finland and extensive foreign cooperation is planned for the doctoral programme.

3 SOCIETAL IMPACT OF RESEARCH AND DOCTORAL TRAINING (MAX. 4400 CHARACTERS WITH SPACES)

- Description of how the RC interacts with and contributes to the society (collaboration with public, private and/or 3rd sector).

The laboratory has the special national task to provide experts of radiochemistry for national positions and it has also provided experts to international bodies such as Euratom, and International Atomic Energy Agency (IAEA). An example of this is the Dr. Olli Heinonen, who was until recently the Deputy Director General of the IAEA.

Long-term industrial cooperation has led to several important applications. Development of commercial sorbent materials with Fortum has created industrial and economic activity and helps to improve nuclear safety and decrease liquid nuclear discharges on a global market. Cooperation with MAP Medical Technologies has helped to provide tracers for clinical PET imaging for patients in university hospitals outside Turku region and thus it has helped to improve the quality of health care in Finland.

The long-term research carried out on migration and retention of radionuclides has been very important for the Finnish national energy policy and has provided important data and tools on the safety assessment of final disposal of nuclear waste. The research work at HYRL creates basic scientific understanding that is needed for adequate safety analysis of the final disposal of spent nuclear fuel and thus also helps in obtaining general acceptance for the safe use of nuclear power.

Development of new radiopharmaceuticals for diagnostic applications and for applications in drug development is anticipated to improve health and drug safety in future, however the most immediate influence of radiopharmaceutical chemistry research at the HYRL is that it makes it possible to educate new radiochemists with the most timely knowledge in modern radiopharmaceutical chemistry for expert tasks in hospitals, university research centers and industry. In addition to the radiopharmaceutical chemistry research, the laboratory has an important national role in the education of radiochemists to radiopharmaceutical applications in Finland.

Environmental research has provided, from the early 1960s onwards, important information on the behaviour of natural and artificial radionuclides in the environment and in food chains and has helped Finnish regulators to assess and devise methods to protect public health against radioactive pollution and natural radioactivity. Of essential importance with this respect are the recent studies that have cleared the spatial distribution of transuranium elements in the whole of Finland.



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Through its vast contacts with industry, academia and authorities nationally and at international level, the laboratory is well-known both at national and international levels. Since HYRL is the only general radiochemistry unit in Finland the head of the laboratory and other senior members are not only representing the laboratory but the radiochemistry area in various national meetings and committees.

In a very recent assessment of the chemistry research in Finland organised by the Academy of Finland the international evaluators concluded on the research interaction of HYRL that "The actual and potential benefits to Finnish society are noteworthy". Regarding research a quality, it was also concluded that "Support from both industry and government is strong; for both partners, the unit appears to be a vital re

- Ways to strengthen the societal impact of the RC's research and doctoral training.

The most important task in strengthening the societal impact of HYRL is to carry out higher quality research and educate adequate numbers of masters and doctors to serve the needs of society. There are also a few special ways to improve societal impact. First, the visibility of the research should be considerably increased and not only to the scientific and technical community but also to the general public. Secondly, as HYRL is the only general radiochemistry representative in Finland its senior staff members should be more represented as experts in various governmental and societal committees and bodies.

4 INTERNATIONAL AND NATIONAL (INCL. INTERSECTORAL) RESEARCH COLLABORATION AND RESEARCHER MOBILITY (MAX. 4400 CHARACTERS WITH SPACES)

- Description of the RC's research collaborations and joint doctoral training activities and how the RC has promoted researcher mobility.

HYRL has a wide range of both national and international partners. In the research on migration and retention of radionuclides in the geosphere the most important national partners are the Technical Research Centre of Finland, Geological Survey of Finland, Aalto University, Jyväskylä University and the Finnish Radiation and Nuclear Safety Authority (STUK). The international partners in this field are Poitiers University and CEA from France, Karlsruhe Institute of Technology from Germany, and Royal Institute of Technology from Sweden. The connections to the Finnish and Swedish nuclear industry are also very close and their funding covers a large fraction of the research in this field. HYRL has participated in the international Grimsel Test Site projects in Switzerland since 2005. The project cluster is focused on research and development of final disposal of nuclear waste at the underground rock laboratory. During the assessment period HYRL has participated in several EU funded projects, such as FUNMIG in 2004-2008, RECOSY in 2009-2013, Actinet Network and POSINAM project which is a Marie Curie Industry and Academy Partnerships and pathways project in 2009-2013. The main partner in the development of inorganic ion exchangers has been already for more than twenty years Fortum company which has commercialized the ion exchangers developed at HYRL. In this field there are also several academic partners, such as Lappeenranta University and Arcada Polytechnic and also other industrial partner, such as Kemira. The radiopharmaceutical chemistry group also has a number of national (University of Turku, Turku PET Center, University of Eastern Finland, University of Helsinki: Faculty of Pharmacy, Center for Drug Research (CDR) and Finnish Institute of Molecular Medicine) and international (Amsterdam Free University, Karolinska Institutet, Stockholm, Human Brain Institute, St. Petersburg) partners. In radioecology HYRL has closely collaborated with STUK and the Finnish Meteorological Institute and with DTU-Risø from Denmark. HYRL has also participated in four NKS (Nordic Nuclear Safety Programme) projects in 2005-2010. In the beginning of the assessment period the mobility of researchers from and to HYRL was fairly low and has considerably increased towards the end. At the end on 2010 the international researchers at HYRL consisted of one Marie Curie visiting



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professor, one visiting researcher and two ERASMUS masters students. At the same time three doctoral students from HYRL were working abroad, one in Karlsruhe and the other two in Stockholm. Four professors from other countries (Loughborough University, UK, Royal Institute of Technology, Sweden, Karlsruhe Institute of Technology, Germany, and University of Poitiers, France) also act as co-supervisors of HYRL's doctoral students.

- RC's strengths and challenges related to research collaboration and researcher mobility, and the actions planned for their development.

The importance of the partners becomes clear from fact that from all research papers in 2005-2010 (about 140 journal articles and conference papers) 56% included a national partner as a co-author and 47% an international partner. The large number of collaborators enables multidisciplinary expertise and use analytical techniques not available at HYRL and they are thus an essential element in HYRL's research. The four foreign professors acting as co-supervisor to HYRL's doctoral students bring additional expertise and increase the quality of doctoral thesis work. The strategy of HYRL is that all doctoral students spend 6-12 months in universities and institutes abroad and that they get there trained to methods not accessible at HYRL. Furthermore, HYRL aims to get more international masters and doctoral students as well as postdocs to Finland.

5 OPERATIONAL CONDITIONS (MAX. 4400 CHARACTERS WITH SPACES)

- Description of the operational conditions in the RC's research environment (e.g. research infrastructure, balance between research and teaching duties).

The facilities of HYRL are modern and well equipped. The laboratory has a wide range of modern instruments for the measurement of all types of radiation (four gamma spectrometers, five liquid scintillation counters, more than twenty alpha spectrometers). The laboratory has several C-type laboratories and three B-type laboratories for handling intermediate radioactivity levels of all basic types of radionuclides, including alpha-emitting natural radionuclides and transuranium elements, which is not very typical for an academic radiochemistry unit. A major research instrument in the laboratory is the IBA cyclotron which is mainly used to produce short-lived positron emitting radionuclides (^{11}C and ^{18}F) for labelling of radiopharmaceuticals. The cyclotron's external beam line was upgraded extensively in 2009 to accommodate materials science projects and the number of external target positions was increased to three. The laboratory has also two whole-body counting systems for measuring body-burden radioactivity. The mobile unit has been used for measuring Sami people in Finnish Lapland, most recently in 2005. The laboratory has also a large ^{60}Co gamma irradiation source which is mainly used in polymerization of MMA for the characterization of rock pores.

During the last few years the laboratory has purchased new types of instruments, such as an ICP mass spectrometer together with the Department of Geosciences and Geography, HPLCs, a particle size analyzer, and participated in purchasing new electron microscopes (FESEM-EDAX and FIB-SEM-EDAX) to the Department of Chemistry. In addition the laboratory has access to high resolution ICP-MS at the Geological Survey of Finland. For many chemical studies the laboratory has none of its own equipment. The laboratory's researchers have, however, access to equipment in the other laboratories in the Department of Chemistry, such as mass-spectrometers, NMR-spectrometers and X-ray diffractometers. In addition to these, chemical analyses are done in other institutes, both in Finland and abroad, for example NMR studies in Tallinn, Estonia, and TRLFS studies in Karlsruhe, Germany. Use of advanced chemical techniques in radiochemical research in the laboratory has essentially increased during the last ten years.



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A major effort during the last five years has been reconstruction and modernization of the research infrastructure for the radiopharmaceutical chemistry group. A gas target for ^{11}C production, in addition to two existing ^{18}F targets, was installed in the cyclotron in 2007. Two lead-shielded hot-cells, together with automated synthesis units were installed in 2006 (^{18}F) and 2009 (^{11}C). A small animal laboratory was built and equipped during years 2007 and 2008 for housing up to 120 rodents in air flow cabinets for evaluation of new radiotracers with ex vivo autoradiography and in ex vivo biodistribution studies. The animal laboratory enables preclinical studies which were not earlier possible in the laboratory. In addition, the radiopharmaceutical group has access to small animal SPECT/CT instrument in the Faculty of Pharmacy. After these constructions the radiopharmaceutical group has all the essential facilities for carrying out novel research in their specialty area.

- RC's strengths and challenges related to operational conditions, and the actions planned for their development.

A major research resource of HYRL is the large number of qualified and motivated researchers. The laboratory has one professor, two university lecturers (associate professors), almost ten senior researchers and postdocs and thirteen doctoral students. Most of them are radiochemists who have received their basic education in radiochemistry in the laboratory. Another strength is the good funding situation and the broad range of external funding sources.

The next plan in improving the infrastructure is to purchase another ICP-MS in a few years and connect it with an HPLC to be able to carry out on-line chemical speciation of radionuclides and stable elements. Another goal in the future is to get a small animal PET/CT scanner, either to the laboratory or to the neighbouring campuses to improve the capabilities of preclinical research in radiopharmaceutical development. This equipment is, however, very expensive and would require large support from the university and close collaboration with the faculties of pharmacy and medicine.

6 LEADERSHIP AND MANAGEMENT IN THE RESEARCHER COMMUNITY (MAX. 4400 CHARACTERS WITH SPACES)

- Description of the execution and processes of leadership in the RC, how the management-related responsibilities and roles are distributed in the RC and how the leadership- and management-related processes support high quality research, collaboration between principal investigators and other researchers in the RC, the RC's research focus and strengthening of the RC's know-how.

The Laboratory of Radiochemistry is headed by the professor who is responsible for finances of the laboratory, recruitment of staff and he works as a superior of the staff members. In these responsibilities he is aided by one of the two university lecturers. The finances of part of the research projects (Academy of Finland, TEKES, EU) are managed also by researchers (presently four) who have organised the funding. In addition to professor there are three other principal investigators (PI) at HYRL, including the two university lecturers and the head of the radiopharmaceutical group. Each PI represents one of the four main research areas in the laboratory and are responsible for supervising most of the doctoral students. Only one quarter of HYRL's funding comes from the university's budget and it goes entirely to salaries of seven persons (professor, two university lecturers, two laboratory managers, secretary and a laboratory technician). Salaries of all other persons, more than twenty, and all research are covered by external funding. The laboratory head collects the overheads (approximately 200.000 € annually) of the projects to the laboratory's account and they are used to cover costs of teaching and laboratory maintenance. In addition they are used for additional salaries and purchasing new research equipment. The whole personnel gather every second week at a laboratory meeting in which most tasks of laboratory management are discussed, including purchasing of new equipment. The strategy of HYRL is to motivate all persons in the discussions and planning of HYRL's activities as a whole. For example,



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last year when the Academy of Finland organised chemistry research evaluation in Finland HYRL's staff had two seminars in which SWOT analysis was carried out and research strategy for the coming years was planned. All doctoral students have both teaching responsibilities and limited responsibilities in running the daily-based laboratory practices. All senior researchers have more demanding responsibilities and the tasks are delivered as evenly as possible. HYRL has its own quality system and most responsibilities are documented in the quality manual. The project leaders run the research work independently and project workers report on the progress frequently (once a year) at laboratory seminars organised every second week.

- RC's strengths and challenges related to leadership and management, and the actions planned for developing the processes.

The strength of HYRL is that there are a large number of senior researchers that are responsible for searching for research funding and supervising the work of doctoral students. A fairly small number of postdoctoral level researchers, taking care of daily-based project running and supervising the doctoral students, is a shortcoming and their number should be increased. The good level of motivation in the personnel towards development of the laboratory as whole is also a major strength. The quality system and the quality manual which are connected to the quality system of Department of Chemistry will be updated and audited frequently and this process will take place in this spring.

7 EXTERNAL COMPETITIVE FUNDING OF THE RC

- Listing of the RCs external competitive funding, where:
 - the funding decisions have been made during 1.1.2005-31.12.2010, and
 - the administrator of the funding is/has been the University of Helsinki
- Academy of Finland (AF) - total amount of funding (in euros) AF has decided to allocate to the RC members during 1.1.2005-31.12.2010: 640000
- Finnish Funding Agency for Technology and Innovation (TEKES) - total amount of funding (in euros) TEKES has decided to allocate to the RC members during 1.1.2005-31.12.2010: 580000
- European Union (EU) - total amount of funding (in euros) EU has decided to allocate to the RC members during 1.1.2005-31.12.2010: 270000
- European Research Council (ERC) - total amount of funding (in euros) ERC has decided to allocate to the RC members during 1.1.2005-31.12.2010:
- International and national foundations – names of international and national foundations which have decided to allocate funding to the RC members during 1.1.2005-31.12.2010, and the amount of their funding (in euros).
 - names of the foundations:
 - total amount of funding (in euros) from the above-mentioned foundations:
- Other international funding - names of other international funding organizations which have decided to allocate funding to the RC members during 1.1.2005-31.12.2010, and the amount of their funding (in euros).
 - names of the funding organizations: Nordic Nuclear Safety Research Programme NKS
 - total amount of funding (in euros) from the above-mentioned funding organizations: 45000



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- Other national funding (incl. EVO funding and Ministry of Education and Culture funded doctoral programme positions) - names of other national funding organizations which have decided to allocate funding to the RC members during 1.1.2005-31.12.2010, and the amount of their funding (in euros).
 - names of the funding organizations: Finnish Research Programme in Nuclear Waste Management, Center for International Mobility CIMO
 - total amount of funding (in euros) from the above-mentioned funding organizations: 1392000

8 RC'S STRATEGIC ACTION PLAN FOR 2011–2013 (MAX. 4400 CHARACTERS WITH SPACES)

- Description of the RC's future perspectives in respect to research and doctoral training.

Most probably studies on migration and retention of radionuclides in the geosphere will remain the main research line in the laboratory for the next ten years. The start of the final disposal of spent nuclear fuel in Finland in 2020 and construction of new nuclear power plants will certainly increase the need for qualified radiochemical research. Scientifically, the aim is to understand the radionuclide processes deeply at atomic and molecular scale alongside with the study of the bulk phenomena of radionuclide sorption and migration processes. To achieve this, novel advanced physicochemical techniques, such as optical and mass spectroscopies, are being and will be used to explore radionuclide speciation in geological environment and to solve sorption mechanisms. The results obtained this way are not only scientifically interesting but also bring certainty to the safety analysis on disposal concept for spent nuclear fuel.

Nuclear imaging (PET and SPECT) has become a daily routine not only in clinical medicine, but also in biomedical research and in drug discovery. It is increasingly applied in basic research when disease mechanisms are studied and in the preclinical stage of drug development. More and more often tracers are tailored for specific and novel applications such as for studying new nanomaterials for drug delivery purposes. The strategic plan of the laboratory is to take an advantage of its unique position as an academic and non-clinical radiopharmaceutical chemistry unit and strengthen its role as a basic research site for development of novel tracers for new imaging applications.

In radioecological research there is no foreseeable large increase in the future. The increasing trend in this area is to study the behaviour of natural radionuclides rather than the pollutant ones, since the former have a larger role in irradiation dose to humans. Especially interesting are radium, radiolead and polonium which are also scientifically most challenging. Study of the pollutant nuclides will still remain important at least for emergency preparedness.

In radioanalytical chemistry the trend is to develop speciation methods and determination methods for very long-lived radionuclides, such as radioisotopes of cesium, iodine, selenium, niobium etc., which are very difficult to measure with radiometric methods. Various mass spectrometric techniques offer much better sensitivities for this purpose. The laboratory already purchased a few years ago an ICP-MS which can be used to measure radionuclides, such as those of uranium and plutonium. A more advanced technique to measure long-lived radionuclides is accelerator mass spectrometry (AMS) by which extremely low concentration can be measured. In Finland there is no such instrument for the measurement of ¹²⁹I, the longest lived isotope of iodine, and therefore the measurements have been measured in Uppsala University. Determination of long-lived isotopes does not only require advanced measurement techniques but also new chemical separation techniques which is the most important role for the laboratory.



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Regulatory pressures to achieve “zero-level” discharges in the near future make it important to develop more efficient materials for radionuclide separations from nuclear effluents. Target nuclides include ^{99}Tc and ^{125}Sb , which often exist in oxoanionic form and are difficult to remove by standard methods. Another important task is the removal of long-lived ^{63}Ni . Also, the functionality of inorganic materials at extreme chemical conditions should be improved. A new important international topic is the separation of actinides in the novel fuel cycles anticipated for the new generations of nuclear reactors and cooperation in this field will be sought.

HYRL is presently the only general radiochemistry unit in Finland and among the largest academic radiochemical institute worldwide. The goal in the next five years is to become a leading academic radiochemistry unit in the world considering both scientific output and the number of doctoral degrees.

9 SHORT DESCRIPTION OF HOW THE RC MEMBERS HAVE CONTRIBUTED TO THE COMPILATION OF THE STAGE 2 MATERIALS (MAX. 1100 CHARACTERS WITH SPACES).

The main responsibility of the compilation the material has been with the laboratory head but the three other principal investigators have helped him greatly in this. All the material was delivered to laboratory personnel in the beginning of February and was openly discussed in the laboratory meeting in the middle of February. The material was edited based on the comments received in the laboratory meeting.



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1 Analysis of publications

- Associated person is one of Anu Airaksinen ,
Matti Hakanen ,
Maria Huittinen ,
Oskari Jokelainen ,
Risto Harjula ,
Pirkko Hölttä ,
Maarit Kelokaski ,
Mari Lahtinen ,
Stewart Alan Makkonen-Craig ,
Outi Perhola, Esa J Puukko ,
Urho Juhani Suksi ,
Kaisa Marjatta Vaaramaa ,
Emad Eldeen Borai ,
Jussi Oskari Ikonen ,
Teija Susanna Koivula ,
Anumajja Anneli Leskinen, Tiina Irmeli Lipponen, Merja Lusa
Airi Annikki Paajanen ,
Mirkka Sarparanta ,
Mervi Johanna Söderlund ,
Heini J Ervanne ,
Kerttuli Helariutta ,
Jussi Sakari Jernström, Lalli Mikko
Nina
Risto Koivula ,
Reijo Kalevi Pehrman ,
Marja Kyllikki Siitari-Kauppi ,
Hanna Pauliina Tuovinen ,

Publication type	Publication Year						Total Count 2005 - 2010
	2005	2006	2007	2008	2009	2010	
A1 Refereed journal article	5	15	7	10	20	16	73
A3 Contribution to book/other compilations (refereed)	1		2	6	1		10
A4 Article in conference publication (refereed)	4	6	6	6	11	5	38
B1 Unrefereed journal article	1	1	1				3
B2 Contribution to book/other compilations (non-refereed)		1					1
B3 Unrefereed article in conference proceedings		2			1		3
C1 Published scientific monograph		1	1	1	1	1	5
C2 Edited book, compilation, conference proceeding or special issue of journal	1	7	3	3	3		17
D4 Published development or research report		1				3	4
H1 Patents				1	1		2



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2 Listing of publications

A1 Refereed journal article

2005

Aaltonen, J., Gromova, EA, Helariutta, K., Jakovlev, VA, Trzaska, WH, Huikari, J., Kolhinen, VS, Rinta-Anttila, S **2005**, 'Production of $^{234,235}\text{Np}$ and ^{236}Pu in bombardment of ^{238}U with protons in the energy range from 17 to 40 MeV', **Radiochimica Acta**, vol 93, no. 7, pp. 377-380.

Koivula, T., Perhola, O., Kämäräinen, E., Lipponen, T., Vepsäläinen, J., Solin, O **2005**, 'Simplified synthesis of N-(3-[^{18}F]fluoropropyl)-2[beta]-carbomethoxy-3[beta]-(4-fluorophenyl)nortropane ([^{18}F][beta]-CFT-FP) using (^{18}F)fluoropropyl tosylate as the labelling reagent', **Journal of Labelled Compounds & Radiopharmaceuticals**, vol 48, no. 6, pp. 463-471.

Kuronen, M., Harjula, R., Lehto, J **2005**, 'Comparison of techniques for measuring ion exchange selectivities in zeolites', **Radiochimica Acta**, vol 93, no. 2, pp. 119-123.

Salminen, S., Paatero, J., Jaakkola, T., Lehto, J **2005**, 'Americium and curium deposition in Finland from the Chernobyl accident', **Radiochimica Acta**, vol 93, no. 12, pp. 771-779.

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Gromova, EA, Jakovlev, VA, Aaltonen, J., Ervanne, H, Helariutta, K, Lunden, A, Makkonen-Craig, S, Perhola, O, Salminen, S, Tuovinen, H **2006**, 'Training of Finnish radiochemists in the production of short-lived transuranic nuclides', **Radiochemistry**, vol 48, no. 6, pp. 603-605.

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Kämäräinen, E., Haaparanta, M., Siitari-Kauppi, M., Koivula, T., Lipponen, T., Solin, O **2006**, 'Analysis of ^{19}F -labelled synthesis products on TLC plates: comparison of radioactivity scanning, film autoradiography, and a phosphorimaging technique', **Applied Radiation and Isotopes**, vol 64, no. 9, pp. 1043-1047.

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RC-SPECIFIC TUHAT COMPILATIONS OF PUBLICATIONS DATA 2005-2010

HYRL/Lehto

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2007

Aaltonen, J, Gromova, EA, Helariutta, K, Jakovlev, VA **2007**, 'Separation of ^{236}Pu and ^{237}Pu tracers from weighable amounts of uranium and neptunium using anion-exchange resin and TRU resin', **Radiochemistry**, vol 48, no. 6, pp. 599-602.

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Grahn, T, Dewald, A, Moeller, O, Julin, R, Beausang, CW, Christen, S, Darby, IG, Eeckhaudt, S, Greenlees, PT, Gorgen, A, Helariutta, K, Jolie, J, Kettunen, H, Kroell, T, Kruecken, R, Jones, P, Juutinen, S, Le Coz, Y, Leino, M, Leppanen, A, Maierbeck, P, Melon, B, Meyer, DA, Nieminen, P, Nyman, M, Page, R, Pakarinen, J, Petkov, P, Rahkila, P, Saha, B, Sandzelius, M, Saren, J, Scholey, C, Uusitalo, J **2007**, 'Collectivity in neutron-deficient Pb and Po nuclei', **European Physical Journal. Special Topics**, vol 150, pp. 121-122.

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Sardini, P, Robinet, JC, Siitari-Kauppi, M, Delay, F, Hellmuth, KH **2007**, 'Direct simulation of heterogeneous diffusion and inversion procedure applied to an out-diffusion experiment: test cause of Palmottu granite', **Journal of Contaminant Hydrology**, vol 93, pp. 21-37.

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Koivula, T, Marjamäki, P, Haaparanta, M, Fagerholm, V, Grönroos, T, Lipponen, T, Perhola, O, Vepsäläinen, J, Solin, O **2008**, 'Ex vivo evaluation of N-(3[^{18}F]fluoropropyl)-2 β -carboxymethoxy-3 β -(4-fluorophenyl)nortopane in rats', **Nuclear Medicine and Biology**, vol 35, pp. 177-183.

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HYRL/Lehto

2009

- Alonso, U, Missana, T, Garcia-Gutierrez, M, Patelli, A, Siitari-Kauppi, M, Rigato, V **2009**, 'Diffusion coefficient measurements in consolidated clay by RBS micro-scale profiling', **Applied Clay Science**, vol 43, pp. 477-484.
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INTERNATIONAL EVALUATION OF RESEARCH AND DOCTORAL TRAINING AT THE UNIVERSITY OF HELSINKI

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2010

Bimbo, LM, Sarparanta, M, Santos, HA, Airaksinen, AJ, Makila, E, Laaksonen, T, Pelttonen, L, Lehto, V, Hirvonen, J, Salonen, J **2010**, 'Biocompatibility of Thermally Hydrocarbonized Porous Silicon Nanoparticles and their Biodistribution in Rats', **ACS nano.**, vol 4, no. 6, pp. 3023-3032.

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A3 Contribution to book/other compilations (refereed)

2005

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B1 Unrefereed journal article

2005

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2006

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2006

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C2 Edited book, compilation, conference proceeding or special issue of journal

2005

Paajanen, A, Harjula, R (eds) **2005**, *Hydrometallurgisten prosessien orgaanisten jäteliuosten käsittely*, **[VTT], [Helsinki].**

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Hakanen, M, Ervanne, H (eds) **2006**, *The influence of organic cement additives on radionuclide mobility: a literature survey*, **Posiva : Working report, no. 6, Working report, Posiva.**

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Siitari-Kauppi, M, Leskinen, A, Kelokaski, M, Togneri, L, Alonso, U, Missana, T, Garcia-Gutierrez, M, Palelli, A (eds) **2007**, *Physical matrix characterization: studies of crystalline rocks and consolidated Clays by PMMA method and electron microscopy as a support of diffusion analyses*, **Informes Tecnicos Ciemat, no. 1127, Madrid.**

Suksi, J, Salminen-Paatero, S (eds) **2007**, *Forsmark site investigation: study of U oxidation states in groundwater with high U concentrations*, **P-reports, no. SKB P-07-54, vol. 2007, Svensks Kärnbränslehantering AB, Stockholm.**

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Paatero, J, Dauvattter, V, Derome, J, Lehto, J, Pasanen, J, Vesala, T, Miettinen, J, Makkonen, U, Kyrö, E, Jernström, J, Isaeva, L, Derome, K (eds) **2008**, *Effects of Kola air pollution on the environmet in the western part of the Kola Peninsula and Finnish Lapland: final report*, **Raportteja / Ilmatieteen laitos, no. 2008:6, Ilmatieteen laitos, Helsinki.**

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2009

Hölttä, P, Hakanen, M, Lahtinen, M **2009**, *Silica Colloids and their Effect on Radionuclide Sorption*, **Posiva Working Report, no. 2009-26, Posiva.**



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Lusa, M, Ämmälä, K, Hakanen, M, Lehto, J, Lahdenperä, A (eds) **2009**, *Chemical and geotechnical analyses of soil samples from Olkiluoto for studies on sorption in soils*, **Working report / Posiva Oy, no. 2009-33, Posiva, Helsinki.**

Markovaara-Koivisto, M, Read, D, Lindberg, A, Siitari-Kauppi, M, Togneri, L (eds) **2009**, *Geology of the Sievi, Kuru and Askola sites: uranium mineralogy of Askola samples*, **TutkimusraporttiA, no. 4, Helsinki University of Technology, Espoo.**

D4 Published development or research report

2006

Siitari-Kauppi, M, Klobes, P, Hellmuth, K **2006**, *Porosity characterisation of selected nanoporous solids*, vol. 2006, **Vantaa.**

2010

Siitari-Kauppi, MK, Ikonen, JO, Kauppi, L, Lindberg, A **2010**, *Investigation of porosity and pore structure adjacent to fractures by PMMA method:: Samples taken from drill cores at Olkiluoto*, vol. Working Report 2010-66.

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Siitari-Kauppi, MK, Ikonen, JO, Lamminmäki, S **2010**, *Investigation of excavation damage zone by PMMA autoradiography method on samples from ONKALO facility at Olkiluoto: Working report*, **Posiva Working Report , no. 118, vol. 2009, vol. 2009, Posiva, Eurajoki.**

H1 Patents

2008

Harjula, R, Lehto, J **2008**, *Method for cesium removal from radioactive waste liquids and method for producing hexacyanoferrates*, 4168172.

2009

Lehto, J, Heikki, L, Harjula, R **2009**, *Granular titanate ion exchangers and method for preparation thereof*, 4428541.



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RC-SPECIFIC TUHAT COMPILATIONS OF OTHER SCIENTIFIC ACTIVITIES 2005-2010

HYRL/Lehto

1 Analysis of activities 2005-2010

Associated person is one of Anu Airaksinen , Emad Eldeen Borai , Heini J Ervanne ,
Matti Hakonen , Risto Harjula , Kerttuli Helariutta , Nina
Maria Huittinen , Pirkko Hölttä , Jussi Oskari Ikonen , Jussi Sakari Jernström, Lalli Mikko
Oskari Jokelainen , Maarit Kelokaski , Teija Susanna Koivula , Risto Koivula ,
Mari Lahtinen , Jukka Lehto , Anumaija Anneli Leskinen, Tiina Irmeli Lipponen, Merja Lusa
Stewart Alan Makkonen-Craig , Airi Annikki Paajanen , Reijo Kalevi Pehman ,
Outi Perhola, Esa J Puukko , Mirka Sarparanta , Marja Kylliikki Siitari-Kauppi ,
Urho Juhani Suksi , Mervi Johanna Söderlund , Hanna Pauliina Tuovinen ,
Kaisa Marjatta Vaaramaa ,

Activity type	Count
Supervisor or co-supervisor of doctoral thesis	8
Prizes and awards	3
Peer review of manuscripts	19
Membership or other role in research network	3
Membership or other role in national/international committee, council, board	6



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HYRL/Lehto

2 Listing of activities 2005-2010

Supervisor or co-supervisor of doctoral thesis

Anu Airaksinen ,

Supervision of PhD-studies, Anu Airaksinen, 2007 → ..., Finland

Supervision of PhD-studies, Anu Airaksinen, 2010 → ..., Finland

Risto Harjula ,

Supervision of PhD, Risto Harjula, 01.02.2007 → 31.12.2009

Jukka Lehto ,

Väitöskirjatyön ohjaus, Jukka Lehto, 2005

Väitöskirjatyön ohjaus, Jukka Lehto, 2006

Väitöskirjatyön ohjaus, Jukka Lehto, 2006

Marja Kyllikki Siitari-Kauppi ,

Geochemical and mineralogical investigation of overburden profiles in glaciated terrain, Finland, Marja Kyllikki Siitari-Kauppi, 01.10.2007 → 31.10.2008, Hungary

Dissolution of montmorillonite in groundwater simulants, Marja Kyllikki Siitari-Kauppi, 01.08.2008 → ..., Finland

Prizes and awards

Anu Airaksinen ,

GSK Young Investigator Award, Anu Airaksinen, 2006

Award for Young Scientist 2007, Anu Airaksinen, 2007

Jukka Lehto ,

Jorma K. Miettinen ansiomitali - Suomen Kemistiliiton Radiokemistijaosto, Jukka Lehto, 1993 → ..., Finland

Peer review of manuscripts

Anu Airaksinen ,

British Journal of Radiology, Anu Airaksinen, 2008 → ...

Bioorganic and medicinal chemistry, Anu Airaksinen, 2009 → ...

European Journal of Pharmaceutical Sciences, Anu Airaksinen, 2009 → ...

Risto Harjula ,

J. Mater. Chem., Risto Harjula, 19.08.2005 → ...

Separation Science and Technology, Risto Harjula, 04.10.2005

Separation and Purification Technology, Risto Harjula, 03.02.2006

Microporous and mesoporous materials, Risto Harjula, 18.06.2007

Pirkko Hölttä ,

Materials Research Society Symposium Proceedings, Pirkko Hölttä, 2006 → ...

Applied Geochemistry, Pirkko Hölttä, 2010

Journal of Hazardous Materials, Pirkko Hölttä, 2010

Risto Koivula ,

Electrochimica Acta, Risto Koivula, 2002 → ...

Separation Science and Technology, Risto Koivula, 2002 → ...

Hydrometallurgy, Risto Koivula, 2003 → ...



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UNIVERSITY OF HELSINKI

RC-SPECIFIC TUHAT COMPILATIONS OF OTHER SCIENTIFIC ACTIVITIES 2005-2010

HYRL/Lehto

Water Research, Risto Koivula, 2003 → ...

Journal of Hazardous Materials, Risto Koivula, 2004 → ...

Separation and Purification Technology, Risto Koivula, 2004 → ...

Colloides and Surfaces A, Risto Koivula, 2008 → ...

The Chemical Engineering Journal, Risto Koivula, 2009 → ...

Jukka Lehto ,

Reviewer, Jukka Lehto, 1993 → ...

Membership or other role in research network

Risto Harjula ,

Finnish GEN4 Network, Risto Harjula, 01.02.2010 → ...

Pirkko Hölttä ,

Nagra Grimsel Test Site Phase VI, Pirkko Hölttä, 2010 → ..., Switzerland

Jussi Oskari Ikonen ,

Japan Geosciences Union jäsen 2010, Jussi Oskari Ikonen, 2010

Membership or other role in national/international committee, council, board

Anu Airaksinen ,

Membership in a scientific organization, Anu Airaksinen, 1994 → ...

Membership in a scientific organization, Anu Airaksinen, 2000 → ...

Membership in a scientific organization, Anu Airaksinen, 2008 → ...

Supervisor member in a national graduate school, Anu Airaksinen, 2008 → ..., Finland

Membership in a scientific organization, Anu Airaksinen, 2010 → ..., Finland

Kerttuli Helariutta ,

Suomen fyysikkoseuran kiihdytinfysiikan jaosto, Kerttuli Helariutta, 17.03.2005 → 15.03.2007, Finland



INTERNATIONAL EVALUATION OF RESEARCH AND DOCTORAL TRAINING AT THE UNIVERSITY OF HELSINKI

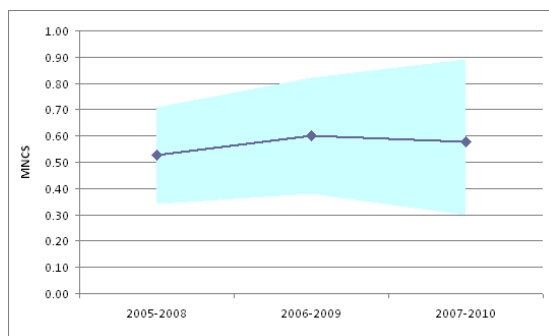
Web of Science(WoS)-based bibliometrics of the RC's publications data 1.1.2005-31.12.2010
by CWTS, Leiden University, the Netherlands

Research Group: Lehto J

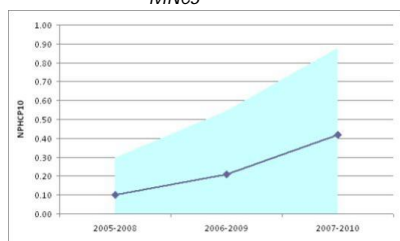
Basic statistics

Number of publications (P)	66
Number of citations (TCS)	96
Number of citations per publication (MCS)	1.46
Percentage of uncited publications	47%
Field-normalized number of citations per publication (MNCS)	.57
Field-normalized average journal impact (MNJS)	1.05
Field-normalized proportion highly cited publications (top 10%)	.29
Internal coverage	.68

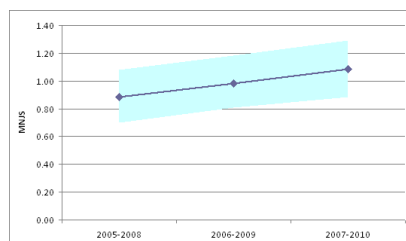
Trend analyses



MNCS

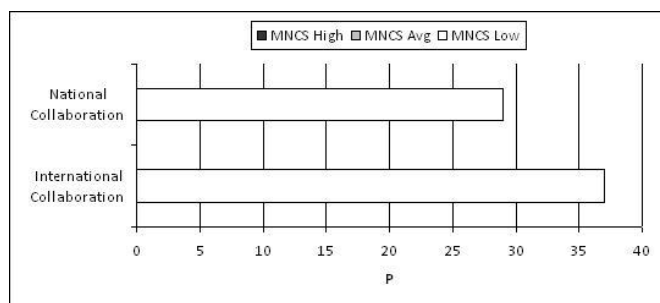


THCP10



MNJS

Collaboration



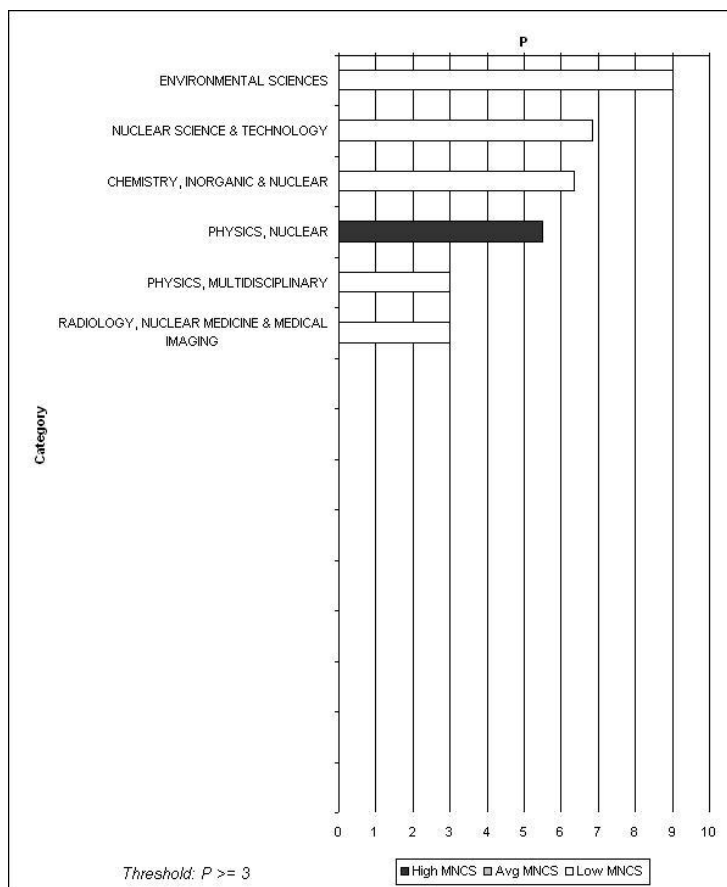
Performance (MNCS) by collaboration type



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Research profile



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